

The American Journal of Surgery

PUBLISHED MONTHLY BY THE AMERICAN JOURNAL OF SURGERY, INC.

49 WEST 45TH STREET, NEW YORK, N. Y.

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NEW SERIES, VOLUME LIII

JULY TO SEPTEMBER

1941

THE AMERICAN JOURNAL OF SURGERY, INC., PUBLISHERS
NEW YORK MCMXLI

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Printed in the United States of America

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The American Journal of Surgery

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A PRACTICAL JOURNAL BUILT ON MERIT

NEW SERIES VOL. LIII

JULY, 1941

NUMBER ONE

Editorial

WORN RUBBER GOODS FOR NATIONAL DEFENSE

MARGARET E. THOMPSON, R.N., of Miami, Florida, made the following appeal, from which we quote in part:

"If you have not already begun to save and to sell your worn rubber gloves, bottle stoppers, tubing, Asepto and ear bulbs, in fact all kinds and grades of rubber goods usually discarded, it is easy to do so, and now is the time to begin, for our government needs all of the rubber it can get.

"Recently, Paul Mallon, (Miami Daily News, January 15, 1941) the newspaper columnist, stated that 300,000 tons of rubber are needed for the national defense program but to that date only 85,000 tons had been bought..

"Perhaps you heard Mr. Harvey S. Firestone, Jr., of the Firestone Tire & Rubber Company, Akron, Ohio, in a radio broadcast last fall, state that our second means of procuring rubber was to conserve that already in the United States.

"Nearly all hospitals, doctors and dentists in private practice, discard daily what to them is worthless rubber, but if saved and sold to scrap dealers would find its way back to commercial reclamation plants, hence available for national defense.

"Mr. Firestone makes the following valuable suggestions about the disposition of used hospital rubber: 'It would be my suggestion that you sell your hospital's scrap rubber, including that from sheeting, hot water bottles, rubber gloves, tubing, etc., to any scrap dealer who will give you the best price for it. In that

way it will find a route to the reclaiming plants and the hospital will obtain some salvage value from it. Market prices of scrap rubber fluctuate the same as do prices of any other commodities. Further, different prices for the same grades will prevail in different communities because of differences in shipping costs that must be incurred to get the rubber to points where it can be reclaimed. Speaking generally, however, the types of scrap rubber which a hospital can accumulate will vary in price from less than a cent a pound to several cents per pound, with gloves and other "pure gum" articles commanding the higher prices. If the scrap is sorted by articles or grades of rubber, it should bring more than if sold in one bulk lot.'

"Usually all that is needed to get doctors in private practice to bring their useless rubber to the hospital, and to get hospital employees to save all worn rubber goods passing through their hands, is to explain to them the Government's need for rubber and to provide conveniently placed receptacles for 'Salvage Rubber.'

"Boxes and cartons in which supplies and equipment were shipped to the hospital make excellent storage containers at no additional cost to the hospital.

"It is surprising in how short a time a salable supply of rubber will accumulate in even a small hospital. The effort is negligible and the esprit de corps such a program stimulates is well worth it."

T. S. W.

Original Articles

THE SURGICAL CORRECTION OF MANDIBULAR PROGNATHISM

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IN spite of difficult and discouraging problems which arise not infrequently in the treatment of mandibular prognathism, remarkable esthetic results are being achieved in such cases by means of various surgical procedures. Less spectacular than the cosmetic effect of these operations but of equal importance is the improvement in masticatory ability and emotional stability of the patient.

The fundamental surgical principles employed in the correction of a protruded lower jaw were established years ago. Yet, so many different procedures, based on these principles, have been advocated in the treatment of this condition that the subject is definitely, if not decidedly, confusing. We should like to present, therefore, those methods which in our experience have proved to be most satisfactory and which incur a minimal number of complications.

Mandibular prognathism has been defined as "an abnormal protrusion of the lower jaw," as "an anterior displacement of the inferior maxilla," or as "a mesial relationship of the lower to the upper dental arches." Although atavism has been suggested as a possible causative factor, heredity undoubtedly is responsible for the development of many protruded mandibles. The majority of lower jaws so deformed probably are the results of processes which disturb the normal eruption of the teeth and the subsequent

growth of the mandible. Too frequently disregarded is the fact that the development, eruptions and ultimate position of the teeth in the dental arches determine the contour of the maxillary bones. As each tooth erupts, the jaws progress another step in development by expanding and changing in form to meet the physiologic requirements of support for the tooth. The conformation of the jaw bones, therefore, is continually being altered until eruption of all the permanent teeth has been completed. Any factor which disturbs the development or position of the teeth may, under favorable circumstances, initiate the occurrence of a protruded lower jaw. The causative factors which induce malposition of the teeth, and in turn, prognathism of the mandible, are inheritance, supernumerary teeth, abnormalities of the tongue, early loss of deciduous teeth, long retention of deciduous teeth, late eruption of permanent teeth, early loss of permanent teeth and improperly made dental restorations. Other general causes are rickets, syphilis and diseases of childhood which not infrequently disturb the normal physiologic processes of the growth and eruption of teeth.

If the cusps of the teeth in a protruded lower jaw interlock firmly with the cusps of the upper dental arch, the degree of protrusion of the mandible will not be augmented after the eruption of permanent teeth has been complete. However, if the

malposition of the jaws is such that the teeth occlude very poorly or not at all, anterior displacement of the mandible may

It is well to mention that such conditions as acromegaly, which induces marked hypertrophy of the lower jaw, are not of

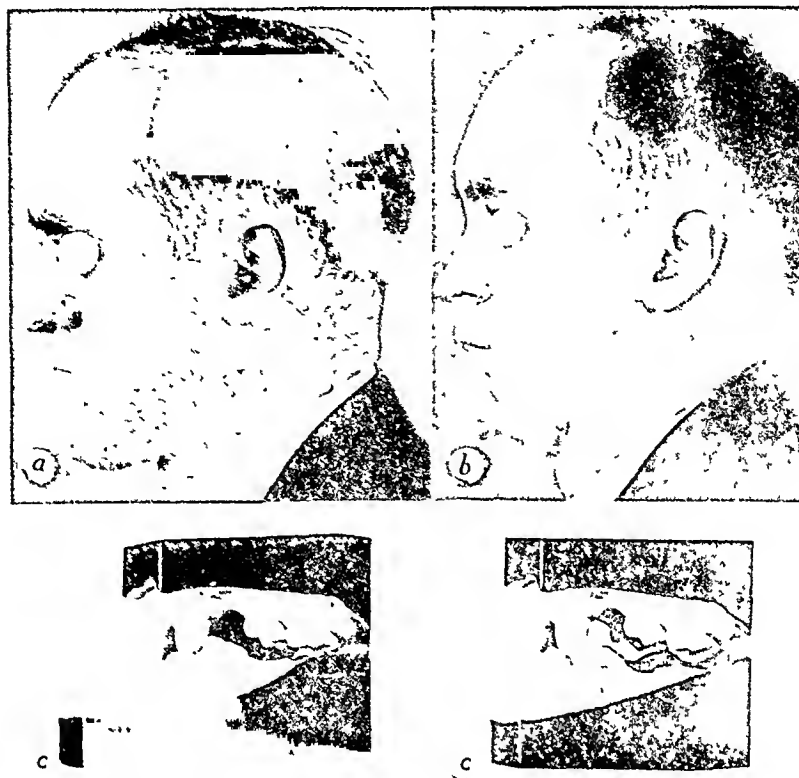


FIG. 1. *a*, preoperative photograph of a patient with a prognathous mandible associated with an old horizontal fracture of the upper jaw which was displaced posteriorly. The deformity was corrected by bilateral resection of a segment of the body of the mandible in the bicuspid region on the left side and in the second bicuspid and first molar regions on the right. Because of the displaced upper jaw, the anterior fragment of the lower jaw was forced back to a position in which the lower anterior teeth were in labial occlusion to the upper anterior teeth. Following extraction of the patient's two upper central incisor teeth, satisfactory dental occlusion was later established by the use of an artificial, partial, upper denture; *b*, postoperative photograph with the patient's artificial upper denture in position; *c*, preoperative dental casts revealing the malrelationship of the jaws and the lack of dental occlusion; *d*, postoperative casts. Occlusion was later corrected by the insertion of the upper denture.

continue indefinitely, later to become more pronounced.

A rare cause of apparent protrusion of the lower jaw is an unreduced horizontal fracture of the superior maxilla which has been driven backward. When such a fracture occurs in childhood, the apparent forward extension of the mandible becomes an actual protrusion since, with the subsequent development of the teeth and surrounding bone, the unrestricted anterior displacement of the lower jaw becomes increasingly more severe.

concern herein because they are of no surgical significance.

The difficulties in a discussion of the factors which contribute to the development of mandibular prognathism are obvious, since so much uncertainty prevails. On an attempt to analyze a series of protruded mandibles, it would be discovered that they do not fit into simple causative categories because many such protrusions are not the result of a single incident but of a succession of circumstances which often are not easy to evaluate. However, from

the standpoint of treatment, the causes of mandibular prognathism are actually of very little importance. On judging the

process it has slid forward; in such mandibles, the angles become markedly rounded or obtuse and not easily demonstrable.



FIG. 2. Roentgenograms of the left side of the jaws of the patient shown in Figure 1; *a*, preoperative roentgenogram; *b*, postoperative roentgenogram. These roentgenograms were taken at a slightly oblique angle, resulting in the appearance of overlapping of the cut ends of the bony fragments between the lower cuspid and first molar teeth.

problem from a preventive point of view, however, the causative background is of the utmost significance. If the aforementioned dental factors, which have been considered to be possible causes for protrusion of the lower jaw, were recognized and corrected during childhood, no doubt many instances of mandibular prognathism could be averted.

Objectively, considerable variation may be observed in any group of protruded mandibles. In this respect, particular reference is made to the degree of anterior displacement present, the size of the mandible itself and the position of the lower teeth in relation to the upper dental arch. All these factors are of importance in determining the course of therapy most suitable in each case. In some prognathous mandibles, the protrusion is so slight that the lower anterior teeth are situated merely in labial occlusion to the upper anterior teeth, whereas in other cases, the inferior maxilla may extend forward for a distance of 1 cm. or more beyond its normal position. Many protruded lower jaws actually are the result of bony hypertrophy or overgrowth in which the mandibular angles are sharply evident and in which the jaw is thick and bulky. Again, there are other cases in which the lower jaw is approximately of normal size but in which by some abnormal physiologic

When the lower posterior teeth are tilted lingually, the mandible is expanded laterally. In all protruded lower jaws, the lower anterior teeth tend to possess a backward inclination. This type of mandibular deformity is always associated with malocclusion, although in instances of only slight anterior displacement, the lower teeth may interlock firmly with the upper dental arch and evidence a strong bite. On the other hand, in instances of marked mandibular protrusion, dental articulation may be entirely lacking, with the result that the patient experiences great difficulty in masticating food.

Occasionally, mandibular prognathism is associated with a small and narrowed upper jaw, a circumstance which increases the visible external deformity. Although of infrequent occurrence, a protruded lower jaw may exist with an "open bite," in which the lower jaw is tilted downward so that the upper and lower anterior teeth fail to meet. Finally, there are patients in whom a protrusion of the lower jaw is not real but is only apparent, being caused by traumatic posterior displacement or by congenital hypoplasia of the upper jaw; in such cases, treatment should be directed to the superior maxilla rather than to the mandible.

TREATMENT

The treatment of mandibular prognathism embodies three phases: esthetic, functional and psychologic. Any operation intended to correct this type of deformity should not only improve the facial contour and functional activities of the jaws but also should benefit the patient's emotional attitude toward his condition. As yet, no operation has been originated which is capable of producing completely satisfactory results in every case. Moreover, all that is implied in the treatment of protruded mandibles cannot be condensed within the narrow scope of a single surgical technic. Consequently, during a period of many years, numerous operative procedures have been devised in an attempt to improve the end results of treatment and to prevent the development of undesirable complications. Each procedure possesses distinct advantages and also, we may stress, definite disadvantages. In their enthusiasm for one special technic, some surgeons apparently disregard or greatly minimize the unsatisfactory features of the method. As a matter of fact, in some of these operations the adverse attributes conspicuously overshadow the alleged advantages. The technics which should be employed, of course, are matters of personal opinion and experience. The decision is a question of determining whether, in view of certain possible complications, the advantages of a certain procedure are of sufficient significance to warrant its use. In the following pages, we wish to present our views on the subject and to outline the technic which we find preferable in most instances.

The methods employed in correcting mandibular prognathism may be grouped as follows: (1) Bilateral resection of a segment of the mandible in the bicuspid or first molar regions; (2) bilateral resection of a portion of the body of the mandible near the angles; (3) osteotomy of the ascending rami above the mandibular foramina; (4) osteotomy through both necks of the

mandible; (5) removal of the condyles; and (6) use of orthodontic methods.

Bilateral resection of a portion of the

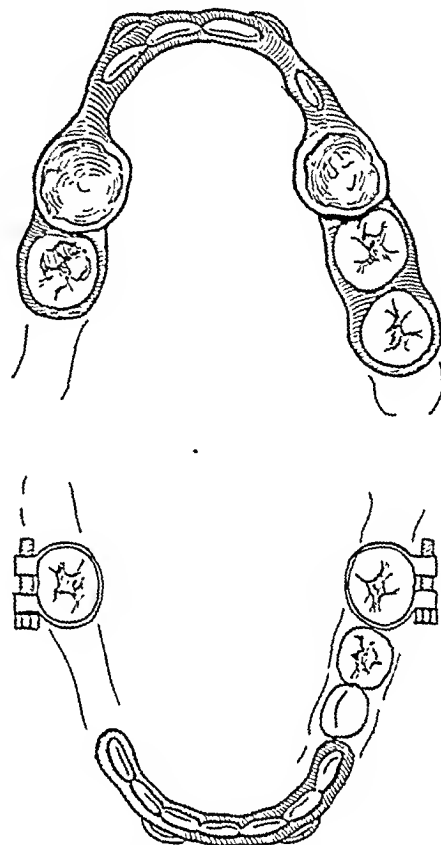


FIG. 3. An effective method of fixation of the bony fragments following surgical resection of bilateral segments of the lower jaw for mandibular prognathism. The above drawing shows the dental appliances which were used for such fixation for the patient in Figure 1. On the upper arch is seen a cast silver splint with oclusal sockets for the reception and retention of the lower first molar teeth when the jaws are closed. On the lower arch another cast silver splint surrounds the lower anterior teeth, and a molar band with its buccal sheath is attached to each lower first molar tooth. These mechanical devices are cemented to the teeth a day prior to the operation on the lower jaw. The use of the dental appliances in the immobilization of the mandibular fragments is described in Figure 4.

mandible in the bicuspid or first molar regions for the correction of mandibular prognathism has been practiced for many years. In general, we believe that this method is preferable in the majority of

cases. Access to the lower jaw is gained through bilateral incisions in the skin. Following resection of the desired portions of

perforation that will communicate with the oral cavity. In this method, if the regions in which the sections of bone are to be re-

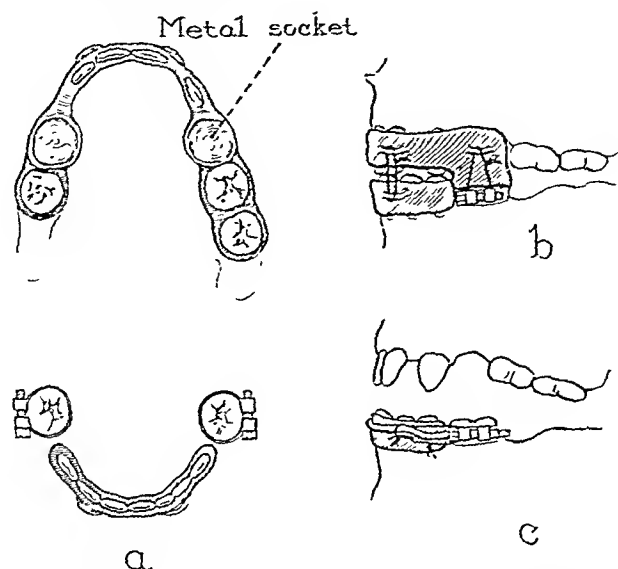


FIG. 4. Use of the mechanical appliances shown in Figure 3; a, relative position of the lower splint to the lower first molar teeth after the lower bicuspid teeth have been extracted and the bony segments resected; b, following removal of the two portions of the mandible, the anterior fragment may be forced back to the desired position and wires may be stretched from the lower casting and molar bands to the casting above. These wires firmly fix the lower jaw fragments to the upper dental arch. Not shown in the drawing is the wire stretched between the molar band and lower casting on either side; these wires maintain the cut ends of the fragments in close approximation; c, after four weeks of immobilization, the upper casting and intermaxillary wires are removed and are replaced by a heavy round wire arch bar; the ends of this bar are inserted into the sheaths of the two molar bands and the bar itself is securely anchored to the lower casting by wires. Such an arch bar gives adequate fixation of the bony fragments at this stage and allows the patient free mobility of his jaws.

bone, the anterior fragment is displaced backward in such a manner that not only the cut ends of the anterior and posterior fragments lie in apposition, but also, the lower anterior teeth occupy a normal relationship to the upper anterior teeth. The segments of bone may be removed in one of two ways as described by Blair and others. The first is the "closed" or "submucoperiosteal" plan in which the periosteum in the bicuspid or first molar regions is reflected away from the mandible prior to resection of the segments of bone, great care being required not to produce a

moved are not edentulous, the existing teeth must be extracted several months prior to the operation on the bone. The second is the "open" or "transmucoperiosteal" method in which the mandible is exposed both externally and from within the mouth, no attempt being made to elevate the periosteum. This operation we do without injury to the mandibular nerve or vessels.

It is the aim of the first method to eliminate infection of bone by preventing contamination of the wound by oral secretions. However, we prefer the second

method for the following reasons: (1) The sawing can be accomplished with much greater precision; (2) when operating by

much easier to preserve the mandibular nerve and blood vessels. Many surgeons consider severance of the mandibular nerve



FIG. 5. Transmucoepiosteal technic of resection of a segment of the lower jaw in the second bicuspid and first molar regions without injury to the mandibular nerve and blood vessels; a, parallel lines indicate the segment of bone to be removed, and the motor driven circular saw makes two cuts from the lower border of the jaw up close to the level of the mandibular canal; b, a chisel is used to remove the intervening bone; c, two similar parallel cuts are made from above down close to the canal with a Gigli saw, and a chisel cuts away the bone between these two cuts.

the closed method, the surgeon often accidentally produces a small, perhaps unnoticeable, nick or tear in the oral mucous membrane and thus inadvertently contaminates the wound; (3) with adequate drainage, we have never seen osteomyelitis develop as a result of the open method; (4) we are of the opinion that osteonecrosis is more likely to occur if the bone is stripped of its periosteum than if it is not; (5) by means of the open method, it is technically



FIG. 6. Continuation of technic described in Figure 5; a, rongeurs are used carefully to remove the remaining portion of bone about the mandibular nerve and blood vessels; b, the mandibular nerve and vessels are exposed intact; c, the two bony fragments are placed in apposition to each other. If, by means of a curet, a small amount of cancellous bone surrounding the nerve and vessels in either fragment is removed, a cavity is created in which the nerve and vessels can rest without injury.

to be of little consequence, but those of our patients who had the mandibular nerve cut complained bitterly of subsequent numbness, and in some instances, normal sensation in the lower lip never was regained entirely. Consequently, we prefer to employ a technic by means of which the continuity of the nerve is maintained. Although it may require considerable time and patience to remove a segment of the lower jaw without injuring the mandibular nerve and blood vessels, we believe that it

is not a difficult procedure and that the effort is well rewarded by the additional comfort experienced by the patient.

The advantages of bilateral resection of the body of the mandible in the bicuspid or first molar regions for mandibular prognathism may be listed as follows: (1) This method insures accuracy in cutting the bone, because the surgeon has perfect visualization of the field of operation; (2) should nonunion of the bony fragments occur following this operation, union can easily be obtained later by means of a bone graft; (3) use of this method does not result in the development of an open bite, which is a serious complication of some other procedures; (4) this method is particularly well adapted to instances of mandibular protrusion associated with an open bite. The disadvantages of this method consist of the following: (1) Infection of bone is mentioned as a complication of this method, although we have never seen osteomyelitis develop when adequate drainage was instituted; (2) residual scarring in the submaxillary regions occasionally occurs, but if conspicuous, it can be corrected by plastic procedures; (3) this method is most difficult to employ when the lower posterior teeth are absent, because these teeth offer the means of fixation for the posterior fragments, although it would be possible to immobilize the posterior fragments by inserting near the angles wires fixed to a plaster head cast; (4) this method results in a diminution of the size of the lower dental arch, which is of little consequence; and (5) this method is technically more difficult than some of the other methods.

In 1912, Harsha described a method of performing bilateral resection of a rhomboid portion of bone from the body of the mandible between the last molar tooth and the angle. The patient whom he treated by this method obtained an excellent result and the operation was performed in such a manner that both mandibular nerves were preserved intact. Although this procedure does maintain the continuity of the lower

dental arch, we believe that, compared to other methods, it is entirely too difficult to warrant its general use. Furthermore, approximation and immobilization of the fragments by Harsha's plan are difficult without some means of internal fixation in the form of wires, ligatures or bone plates. Such fixation is likely to cause osteonecrosis with a disastrous end result.

In the treatment of a protruded mandible, many surgeons prefer osteotomy of the ascending rami just above the mandibular foramina. By means of this operation, the entire body of the lower jaw may be forced backward to a position that is in harmony with the superior maxilla. If healing of the cut edges of the ascending rami occurs, an excellent result may be anticipated. However, since it is not always possible to manipulate the bony fragments to the desired position, nonunion may occur if they do not lie in close approximation. Invariably, this complication leads to the condition of "open bite," which is even more serious than nonunion. Occurrence of these complications is extremely unfortunate, because they are most difficult and often impossible to rectify, and the patient is left unable to incise and masticate food. Furthermore, the condition of "open bite" sometimes gradually develops even after the fragments have healed by bony union. Although the aforementioned complications probably do not occur frequently, they are of sufficient gravity to have caused us to limit the use of this method to one group of protruded mandibles, namely, those which cannot be corrected by bilateral resection of a portion of the body of the lower jaw because no lower molar teeth are present for fixation of the posterior fragments. If the method of osteotomy through the ascending rami is to be employed, the patient should be informed preoperatively of the remote but possible complications of this procedure. We do not wish to give the impression that this method is to be condemned, because, when it is successful, it produces the finest cosmetic and functional results. We are,

however, of the opinion that this method should not be used indiscriminately.

The procedure of osteotomy through the ascending rami has the following advantages: (1) It is comparatively easy to perform from a surgical standpoint; (2) contamination of the wound by intra-oral secretions is eliminated; (3) the continuity of the lower dental arch is not disturbed; (4) little or no visible scarring is produced; and (5) the mandibular nerve and blood vessels are never injured.

We believe that osteotomy through the necks of the mandible generally does not effect as satisfactory results as do the former methods, and that such a form of osteotomy occasionally leads to the condition of "open bite." However, Pettit and Walrath reported good results achieved by their so-called low back angle.

Dufourmental advocated the removal of both condyles as a means of correcting a protruded lower jaw. However, this method has limited possibilities because it cannot be employed in cases of severe protrusion. Surgeons who have tried this method report that in many cases the condition of "open bite" subsequently develops.

In summarizing the treatment of all types of prognathous mandibles, we wish to clarify our opinions on the subject. As a preliminary measure, considerable deliberation is required to determine the course of treatment best suited to each patient. Roentgenograms of the jaws and teeth, photographs and plaster dental study models are indispensable. The method of therapeutic approach, naturally, differs sharply in children from that used for adult persons. For children and youths, the treatment should be limited to orthodontic procedures, by means of which much can be accomplished. We strongly urge the prompt recognition of early instances of mandibular protrusion as evidenced by malrelationship of the jaws or teeth in children. These young patients should receive expert orthodontic therapy without delay in an effort to prevent the deformity from increasing in severity during the

growing and developmental period of the mandible. Not until the individual who has a protruded lower jaw has reached early adult life should surgical methods of correction be considered. When the degree of protrusion is so slight that the lower anterior teeth merely lie in labial occlusion to the upper anterior teeth, corrective surgical operations are contraindicated. If the condition in such cases cannot be corrected by the orthodontist, we prefer not to attempt treatment at all. We believe that all instances of marked mandibular prognathism in adult patients should be corrected by bilateral resection of a segment of the body of the mandible, provided that one or more lower molar teeth are present on each side for fixation of the two posterior fragments. There can be but little argument to our assertion that this method is the most satisfactory way of dealing with protruded lower jaws associated with "open bite." If, in instances of mandibular protrusion, the upper jaw is congenitally small or is displaced posteriorly, we never attempt to force the mandible back to a point at which the lower anterior teeth are situated in lingual occlusion to the upper anterior teeth. On the contrary, we surgically move the lower jaw backward merely to a position in keeping with normal facial contours; subsequently, the upper dental arch is brought forward into natural articulation with the lower teeth by orthodontic methods whenever feasible or, more commonly, by the use of an artificial, partial denture. (Figs. 1a, b, c and d, and 2a and b.) For patients who have lost their molar teeth and who are particularly desirous of having their protruded mandible corrected, the method which utilizes osteotomy through the ascending rami is indicated. Absolute immobilization of the lower jaw is accomplished in such cases by the use of a cast silver dental splint which is securely cemented to the remaining lower teeth and firmly wired to the upper dental arch. When necessary, increased stability can be obtained by extending the silver casting back over the edentulous alveolar

ridge in both lower molar regions, and by fixing these phalanges to the lower jaw by circumferential wires. Following performance of surgical procedures for the correction of mandibular prognathism, the occlusion of the teeth should receive attention in an attempt to improve the masticatory function of the jaws; such attention may consist in grinding down high dental cusps which interfere with the articulation of the teeth, of the possible utilization of orthodontic measures, or of the use of artificial partial dentures.

As previously expressed, the method of bilateral resection of a segment of the body of the mandible is the one which we prefer to use for the correction of the majority of protruded lower jaws. In performing this operation, the technical details which we have found expedient to employ are as follows: First, impressions of the upper and lower dental arches are secured. Next, from these may be prepared two sets of plaster models; one for purposes of study and the other for use by the dentist in constructing cast silver dental splints; such splints in our experience have proved to be excellent agents for postoperative immobilization of the jaws.

Invaluable and essential are well made study models. Only from such casts can there be effected a satisfactory determination of the size of the segments of bone to be removed. The distance from the labial surface of the lower anterior teeth to the lingual aspect of the incisal edge of the lower anterior teeth to the lingual aspect of the incisal edge of the upper front teeth represents the degree of mandibular protrusion present, unless an associated posterior displacement of the superior maxilla is present. The width of the resected portion of bone on either side of the mandible should equal the degree of anterior displacement of the lower jaw. By examination of the study models, the surgeon can ascertain which teeth necessarily must be extracted and, in turn, just what portions of bone should be resected. Wherever possible, we prefer to sacrifice the second

bicuspid and first molar teeth, because in removing a segment of bone in this region, the surgeon can keep the operative field at a safe distance from the mental foramen and thus avoid possible injury to the emerging mental nerve and vessels. However, when on either side the second and third molar teeth are absent, it is necessary to retain the first molar tooth for fixation of the posterior fragment, and consequently, the segment of bone must be resected in the first and second bicuspid regions.

In a protruded mandible associated with "open bite," the removal of a properly shaped section of bone from each horizontal ramus will correct both deformities simultaneously. Without study models, it would be most difficult to fashion patterns for guidance of the surgeon in resecting segments of bone of appropriate size and contour. Schultz has prepared an admirable diagram by means of which a precise, mathematical determination of such a pattern can be made for each patient. The reader should consult Schultz' paper on this subject.

Much of the success of any surgical operation for the correction of mandibular protrusion is dependent on the effectiveness of the appliances used in immobilization of the bony fragments. Too much consideration of this subject can never be given preoperatively. As far as the operation under discussion is concerned, it may be asserted that the degree of ultimate success or failure of this procedure is proportionate to the ability of the immobilizing agents to maintain the fragments in the desired position until bony union is complete. We rely for immobilization entirely on various forms of dental retention. In general, we prefer cast silver splints and orthodontic molar bands which are cemented to the teeth rather than the conventional wires twisted about the necks of the teeth. The former appliances cannot be displaced and possess the rigidity and stability often lacking in the latter type of dental wiring.

To facilitate a description of the method of dental fixation which we advocate, consider a case of mandibular protrusion in which there is a full complement of upper and lower teeth. Prior to the operation, the dentist obtains the plaster models of the jaws, and cuts away the lower second bicuspid and first molar teeth on each side (the regions in which the segments of bone are to be removed). After the width of the portions of bone to be removed has been ascertained, the lower model is cut into three pieces similar to the fragments of bone which will be formed by the operation. While the anterior plaster fragment is forced back to the desired position, the cut ends of the two posterior fragments are rotated slightly in ward. The three plaster fragments and the upper plaster model are then mounted on a dental articulator in the same relationship as will exist in the mouth after the operation. Since the mandible flares outward from the symphysis to the angles, it is of the utmost importance to rotate the two posterior plaster fragments slightly inward; otherwise, the anterior fragment, when displaced backward, will become telescoped between the two posterior plaster segments. By carrying out the aforementioned treatment to the plaster models, the dentist now has the plaster teeth in the exact position required of the patient's teeth following the operation.

By means of the plaster casts previously described, which are cut and mounted on an articulator, it is possible for the dentist to construct a cast silver splint (Fig. 3), which may be cemented to the upper dental arch. This splint hugs the labial, buccal and lingual surfaces of the upper teeth, spans some of the interproximal spaces, but does not cover the incisal edges or occlusal tooth surfaces. This splint possesses two cup-shaped, occlusal depressions of sockets for the reception and retention of the two lower second molar teeth. A similar type of silver casting is next made to fit the teeth of the lower anterior fragment (Fig. 3). Both upper and lower castings possess hooks for subsequent intermaxillary wiring.

The day before the operation, these castings are cemented in their proper positions. Also, a molar band having a buccal sheath is screwed and cemented to each lower second molar tooth. Following the surgical procedure, heavy intermaxillary wires are stretched between the hooks of the two castings and between the buccal sheaths of the molar bands and the upper casting (Fig. 4*a* and *b*); simultaneously, the lower second molar teeth are seated securely in the cup-shaped depressions above. The round wire arch bar in Figure 4*c* replaces the intermaxillary wires and upper dental casting at a later time, as will be described. These wires firmly bind the upper and lower jaws together. Other wires stretched from the lower casting to the molar bands retain the lower jaw fragments in close approximation.

In resecting bilateral segments of the body of the mandible (Figs. 5*a*, *b* and *c*, and 6*a*, *b* and *c*) the patient is anesthetized preferably with nitrous oxide gas and ether by the intratracheal method. It is necessary first to extract all teeth which are situated in the two portions of bone which it is proposed to remove. If the second or third molar teeth are present, the second bicuspid and first molar teeth on either side must be sacrificed. Following such preliminary measures, an incision in the skin 6 or 7 cm. in length is made in one or the other submaxillary region. The surgeon works through this incision, and the entire circumference of the mandible in the bicuspid and first molar regions is exposed by blunt dissection. The wound, of course, communicates with the oral cavity. By means of an indelible pencil, two parallel lines are drawn on the external surface of the mandible in the second bicuspid and first molar regions. The distance between these two lines represents the width of the segment of bone to be resected. A motor driven circular saw is employed and a cut is made along each of these pencil lines from the lower border of the mandible upward almost to the approximate level of the mandibular canal; this saw should be used

with considerable caution and kept at a safe distance below the mandibular nerve and vessels. A chisel is placed between the upper extremities of the two saw cuts, and by firm tapping with a mallet, the intervening portion of bone is removed. Next, two similar cuts along the pencil lines from the alveolar ridge down close to the mandibular canal are produced by a Gigli saw, and the interposed bone is detached by means of a chisel. With only a small amount of bone remaining about the nerve and vessels, careful use of a rongeur will easily expose these structures intact. Finally, with the aid of a curet, some of the cancellous bone surrounding the nerve and vessels in either fragment is removed; a cavity is thus created in which the exposed portions of the nerve and vessels can rest without injury when the anterior and posterior fragments are brought into apposition.

On completion of the foregoing technical details, an identical procedure is carried out on the opposite side of the lower jaw. A Penrose drain is inserted from within the mouth into the incision on either side; these drains emerge externally through the incisions in the skin. As a final step in the operation, the soft tissues overlying the bone are approximated and the incisions in the skin are carefully sutured. No attempt is made at this time to immobilize the fragments; fixation is postponed until the succeeding day, when the patient is not under the influence of anesthesia and when he is free of nausea.

On the first postoperative day, the patient is returned to the operating room, and his jaws are thoroughly immobilized as has been previously described. Feedings are carried on through a Rehfsuss stomach tube. About one week later the Penrose drains are removed. At the end of another three weeks, at which time some bony union of the fragments should be evident, we usually dispense with the intermaxillary wires and upper dental casting. These appliances are replaced by a round wire arch bar adapted

to the lower dental arch (Fig. 4c); the ends of this bar are inserted into the sheaths of the two lower molar bands and the bar itself is securely anchored to the lower casting by wires. At this stage of the patient's convalescence, such an arch bar gives adequate fixation of the bony fragments and allows the patient free mobility of his jaws. In general, we are in favor of leaving this appliance in position for another four or five weeks, because it is of little inconvenience to the patient and gives support to the newly formed callus. On removal of all intra-oral mechanical devices, dental occlusion is established by grinding down the interfering cusps of teeth. For younger individuals, orthodontic measures are valuable aids in producing firm articulation of the teeth. If noticeable residual scarring in the submaxillary regions occurs, the scar tissue is excised several months later.

SUMMARY

1. The causes of and objective findings in mandibular prognathism have been presented.
2. The relative values of various corrective procedures for this type of mandibular deformity have been discussed.
3. A method consisting of bilateral resection of a segment of the body of the mandible, for mandibular prognathism, has been described. In this procedure, the segment of bone on either side is removed without injury to the mandibular nerve and vessels.

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OSTEOMYELITIS OF THE SPINE TREATED WITH FUSION BY BONE GRAFT

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UP to very recent times the opinion regarding osteomyelitis of the spine was that it was a relatively uncommon disease. This was primarily due to the scarcity of reports in English literature. Recently, there has been an increasing number of cases reported. Especially to be noted is the analysis and discussion of 102 cases by Kulowski.¹ This author particularly stresses that the ratio of tuberculous spondylitis to pyogenic osteomyelitis has been but two to one since interest has been aroused at the Steindler Clinic in this affliction. In general, it appears to be the consensus of opinion that when found it is a very serious disease with a greater mortality than osteomyelitis in other bones.

Our study was started prior to the publication of Kulowski's analysis. In the survey of our own statistics for the past ten years we find records of twelve cases of pyogenic osteomyelitis of the spine. Three of those affected the arches and processes; in one case, both the body and the processes were involved; eight cases affected the body alone. This proportion differs somewhat with the general average as quoted by Steindler,² who finds in a series of collected cases that 58 per cent showed involvement of the arches and processes, and 44 per cent of the bodies alone. Our age limit is somewhat higher than the general average. The youngest was a boy of fourteen with a multiple metastatic bone involvement, including the body of the first lumbar vertebra. Then came patients ranging in age from twenty to fifty-six. The majority of cases was found in those of the third decade. It was very interesting that our oldest patient, the only female, age fifty-

six, presented a similar history, clinical course and x-ray findings as that in Case iv. Refusing operation, she was treated conservatively by means of a Bradford frame for a period of four months and then allowed to go about with the aid of a brace. This patient is still alive three years after hospitalization, and she frequently consults us because of pain in the back. Her latest x-ray examination shows evidence of marked intervertebral joint narrowing and osteo-arthritic changes but not complete fusion. She cannot carry on without her brace. The prognosis in our entire series shows three fatalities. Two deaths occurred in the cases affecting the processes alone, one death in a body involvement. All of these deaths were the result of gradual sepsis following months after the diagnosis was made and surgical procedure instituted. In contrast to other statistics, it is to be noted that seven cases in which the bodies were involved have survived. Two of these patients were treated by transversectomy and drainage. One was treated conservatively, as mentioned above, and the five last, whose case histories are appended, were treated by spinal fusion.

From the literature we find that the *Staphylococcus aureus* is the most frequent exciting agent. In a small percentage of cases the *Staphylococcus albus* and exceptionally the streptococcus are the invading organisms. Since no attempt was made to reach the spinal focus, we cannot say what organisms were present in our cases, except for the indirect evidence of blood cultures or cultures from other foci. In Case 1, a *Staphylococcus aureus* was isolated in the preceding operation for osteomyelitis of

clavicle. In Case iv, *Staphylococcus aureus* bacteremia was present. Blood cultures in the other cases were sterile. Pre-existing histories of other infections are found in all the cited cases. Thus, the history of pneumonia and severe toxemia was elicited in Case I, while in Case III, one notes an acute onset of the spinal symptomatology following operation for appendicitis. The element of direct trauma plays an appreciable rôle in only one case, Case v, in which the onset of symptoms starts with a fall on the buttocks.

Just as in osteomyelitis of other bones, pyogenic infection of the vertebra comes from two sources, i.e., by direct extension or, more frequently, by the hemotogenous route with ensuing thrombo-arteritis or capillary thrombosis. This process results in the vertebra, either in (1) a subperiosteal affection, (2) an epiphyseal separation, (3) a rarifying osteitis, or (4) a completely destructive type. Because of the essential anatomical and vascular conditions as described below, thrombo-embolic lesions in the vertebra are much less frequent in comparison with other bones. When they do occur, the destructive changes produced are limited in their extent. Sometimes only the surface of the vertebra is attacked as in Case iv. At other times, there is a rapid invasion of the spongy substance, which may stop at some stage or progress until the entire body becomes infiltrated with pus and succumbs to necrosis. This is found in the other three cases in varying degrees. Due to the character of the anastomotic circulation, the formation of sequestræ is not constant but abscess formation is very common. In Case iv, x-ray studies beginning with the eighth day after onset of symptoms and repeated observation, show in the fourth week a pathological lesion beginning with a narrowing of the intervertebral disc and rapidly followed by signs of marginal bone necrosis. This bears out the observation of Compere and Garrison² that the intervertebral discs are less able to survive the attack of pyogenic disease than in tuberculosis.

The topics of symptomatology and diagnosis are so closely interwoven that they lend themselves readily to simultaneous discussion. As they apply to osteomyelitis of spine, the general symptoms are those of an acutely ill individual, with intense pain in the back, chills, high temperature and signs of various degrees of intoxication. The additional symptomatology is dependent upon the close relationship between the vertebral column to the spinal cord and also to neighboring cavities and viscera. Local symptoms are pain, rigidity of back, severe localized tenderness, both superficial and deep, and painful motion. These symptoms differ also in their degree and intensity according to the stage of the disease as one finds in osteomyelitis of other bones. Grouping of osteomyelitis in general is known to all and does not bear repetition. Diagnostically, these cases often resemble Pott's Disease. In spinal involvements, secondary to demonstrable infectious process in the soft tissues and other skeletal parts, the diagnosis is more readily made. In their absence, especially in the so-called subacute types of osteomyelitis of the spine the differential diagnosis is somewhat more complicated. In this latter type, the clinical picture may be said to resemble a condensed epitome of Pott's disease without deformity. The tendency to deformity or gibbus formation due to collapse of the involved vertebral bodies is much greater in tuberculosis. The explanation given is that in osteomyelitis, the acuteness and severity of the condition quickly prostrates the patient and keeps him on his back. In pyogenic osteomyelitis, both in general types and also those affecting the spine, the cases that present an extensive and massive distribution usually come to a fatal end much sooner. The pus formation or abscess occurs much more rapidly in osteomyelitis. With osteomyelitis we frequently find evidence of an accompanying septicemia and its various manifestations. A very valuable adjunct in making a differential diagnosis is the x-ray findings. In studying these, we must again repeat that

acute osteomyelitis of the spine passes through the same stages as osteomyelitis of long bones. These stages are influenced by localization and therapeutic factors. In the presence of pyogenic organisms, one invariably finds roentgenologic evidence of degeneration and proliferation at the same time. Kulowski¹ stresses that the most characteristic feature of pyogenic osteomyelitis is the presence of a reactive new bone formation characterized by spike-like projections from the margins of the affected vertebra. This so-called parrot's beak was especially noted in Case v. (Fig. 21.) Telescoping is more frequent in tuberculosis because breaking down of the bodies occurs more extensively in this condition. By contrast with tubercular spondylitis there is a rapid and early involvement of the intervertebral disks in pyogenic infections of the vertebrae.

The above mentioned factors regarding etiology, pathogenesis, symptoms and diagnosis are only briefly mentioned. One can find a more complete description of these phases of the disease in the splendid review by Kulowski. Our attempt has been mainly to emphasize these only as they pertain to the main object of our presentation, i.e., the use of the spinal graft for fusion in this disease.

In the review of the reported cases one is impressed with two outstanding and very important facts. First to be noted is the general failure in making a prompt and early diagnosis. Such patients are frequently treated for rheumatism, arthritis, meningitis, pneumonia, typhoid or some other acute febrile condition for weeks before the true condition is realized. The primary lesion is often overlooked or subordinated to the more extensive secondary purulent infiltrations in the adjacent vital organs or body cavities because of the peculiar anatomical location of the disease. Second, the most striking feature is the employment of a surgical procedure which does not entirely concur with past and present day teaching that all suppurative areas require evacuation and drainage.

In 1930, we were confronted with a problem case. (Case 1.) We had a very sick patient whose general and local condition was gradually getting worse. The inaccessibility of the abscess cavity which appeared to fill a good part of the posterior mediastinal space made the usual procedure of costotransversectomy a very hazardous therapeutic approach. The general condition of the patient did not warrant multiple rib resections. It was decided for reasons later mentioned that there would be much less shock to a spinal fusion, especially since fixation by body cast did appear to relieve his pain. The dramatic suddenness of the improvement and the marked decrease in the mobility had enthused us subsequently to employ this method in four other cases.

In the Iowa series, spinal fusion was performed under the mistaken diagnosis of tuberculosis. Kulowski deems it an unnecessary procedure in view of the tendency in this case to spontaneous fusion. In our series we find various types of pathological involvements. They were not especially selected cases. Despite application of conservative fixation treatment prior to operation the tendency was progression of the destruction rather than spontaneous fusion. Four of the five cases had prolonged bed stay and fixation applied; despite all that, repeated x-ray study showed definite progressive destruction.

RATIONALITY OF THE GRAFT FUSION

In order to appreciate the application of the principles of bone graft fusion in this affection it is necessary at this time to review the essential anatomic factors. Special stress is placed on the vascularity of these bones because we find that it plays a very important rôle in the process of regeneration. The anatomic factors that need be elaborated upon are, (1) the character of the bone, (2) its arterial blood supply, and (3) its venous drainage.

1. *Character of the Bone.* According to Callander,² "Embryologically each vertebra is developed through three primary

centers of ossification, one for the body and one for each vertebral arch. The two halves of the neural arch unite posteriorly in the first year. Five secondary centers appear at puberty and the epiphysis they form add upper and lower plates or disks to the bodies and tips to the spinous and transverse processes. These epiphyses unite about the twentieth to the twenty-fifth year." After complete ossification there exists a definite anatomical and architectural continuity of the cancellous structure of the body and the posterior process of the vertebra. This structural continuity is reflected in the horizontal and vertical trabecular systems. Absence of circumferential cartilage plate and lack of a definite subchondral layer of compact bone, as seen in normal joints, explains the rapid extension of the primary pathological processes into the contiguous disk and vertebral body. It is worth noting that the structure of the periosteum of the vertebra differs from most other bones; there is no true membrane. Rather is there an intimate adherence of periosteum to bone, the result of the innumerable penetrating fibers. This is stressed because the intimate closeness of periosteum to cortex is a factor in supplying an increased blood supply to the bone itself.

2. *Arterial Supply.* A complete description of the circulation has been given in a recent paper by Wagner and Pendergrass,⁵ and the following is freely quoted, "From the abdominal aorta lumbar arteries and branches pass posteriorly, penetrating the anterior muscle group. The dorsal branches (Rami Dorsalis) arise and continue posteriorly in the horizontal plane on either side of the vertebral body, just above midline. Arteries lie in direct contact with a portion of the anterior and entire lateral wall of the vertebral body. From the medial surface of the Rami Dorsalis as they lie in contact with the vertebral body, arise branches which penetrate directly into the bone. These vary in number, but there are commonly present one main antero-lateral and a smaller lateral branch on either side.

These arteries may be followed well into the middle of the vertebral body before they divide and lose their identity. In the region of the intervertebral foramen, the Rami Dorsalis divides into a spinal branch (Ramus Spinalis) and a muscular branch, which supply the muscles and the skin of the back. The Ramus Spinalis passes through the spinal foramen into the spinal canal to anastomose with its fellows and contribute to the anterior and posterior spinal arteries. From each of the anterior spinal arteries, a medial branch arises and passes medially along the posterior wall of the vertebral body. These two branches penetrate the vertebral body in the midline, at a point just about the exit of the veins. These penetrating posterior arteries may be followed well into the central substance of the vertebral body before they divide. Small pairs of nutrient vessels penetrate the posterior vertebral body wall at points just above and below the level of those just described. These latter arise either directly or indirectly from the anterior spinal arteries or their medial branches. From the size of the arteries to the vertebral bodies it can be inferred that the volume flow of blood is relatively small."

3. *Venous Drainage.* The vertebral bodies are drained by an internal system of comparatively large thin-walled channels, spaces and tracts (venous sinusoids). These sinusoids ramify throughout the greater portion of the body and communicate through small openings on the front and side of the bodies with the anterior external and anterior internal vertebral plexuses. As life advances these sinusoids become greatly enlarged. These sinusoids are lined in their central portion with a single layer of endothelial cells, and in their distant bays, lie histiocytic cells. Immediately beneath the lining cells and in the subjacent connective tissue lie numerous macrophages, the fixed wandering cells of Maximow, of high phagocytic powers, and respond rapidly by hyperplasia and the elaboration of defense bodies under the

influence of an irritant. They also contain within their lumen hematopoietic tissue and normal circulatory blood elements. Because of the sluggish movements of the blood stream in these sinuses they act as places both for lodgment or metastases of pyogenic organisms and also for their destruction and removal.

With the above anatomical picture we are now ready to correlate the operative procedures and postoperative follow-up and also to compare them with other methods of therapeutic attacks. In the explanation of the clinical application the following factors lend themselves for special discussion: (1) operative procedure, (2) lack of postoperative reaction, (3) rapid convalescence and markedly diminished time of disability, (4) early bony ankylosis and other regenerative processes and (5) the fate of the abscess.

1. *Operative Procedure.* In all our cases we employed an autogenous tibial graft for spinal fusion according to the technic of Dr. F. H. Albee.⁶ The technic of the operation does not require any repetition as it is universally known. The purposes of the operation are two-fold: first, to immobilize the affected parts, and second, the use of a living graft to act as a stimulant to the osteogenetic forces. The principle of immobilization for inflamed and injured parts, as first promulgated by Hilton,⁷ and Thomas,⁸ has been within recent years greatly popularized in the treatment of osteomyelitis. Orr⁹ aptly states, "Immobilization means first, the replacement as nearly as possible of injury parts in correct anatomic relationship, and second, the maintenance of immobilization in proper relationship until healing occurs." Whether the injury comes from a direct or an indirect traumatic force, or from the presence of an infective agent, the resultant pathology varies only in the degree of the insult. The principles of immobilization hold true both in injury and infection. Nature in its mechanism of taking care of injury or infection asserts itself by producing an attempt at fixation by muscular splintage

or spasm, and limitation of function. As demonstrated in the anatomical discussions of the spine, it is composed of numerous mobile segments, whose action for the most part is that of leverage. Measures must be instituted to limit this action which not only is influenced by trunk motion but also by the motions accomplished in respiration and involuntary actions of the abdominal muscles. It is true that there are other means of fixation besides spinal fusion and these we tried before resorting to fusion. In Case I, the application of a properly applied high plaster jacket afforded local symptomatic relief. The patient's general and local condition, however, grew progressively worse. He continued to run a temperature accompanied by profuse sweating; there was increased bone destruction until the time of operation. In Cases II and IV, one notes that a Bradford frame was used for periods of two and one months, respectively, but this did not retard the progression of symptoms and local signs until the time of operation. In Case V, the patient was in a cast six weeks prior to admission. Another body jacket was applied and worn for ten weeks, followed by a Knight spinal brace and this was worn for two months. During all this time despite fixation the clinical and x-ray picture showed progression of the local and general symptoms. Today, nobody doubts the fact that operative fusion furnishes a form of immobilization which is vastly superior to external splinting.

2. *Lack of Postoperative Reaction.* Patients suffering from pyogenic osteomyelitis of the spine are very sick individuals. Any operative procedure must be accompanied by as little trauma as possible. To avoid postoperative complications, the time factor is of great importance. These are the most important reasons for our choice of the Albee tibial graft fusion operation. With this form of surgical fusion, one is much further afield from the seat of the pathology, and hence, one can escape the danger of infection of the stabilizing agent and prevent future sinus formation. Here

let us interpose the thought that in cases in which the involvement is primarily in the processes, surgical fusion would be contraindicated. The trauma is considerably less than in any other type of fusion operation; the danger of the anesthetic is lessened by the decreased time of the operation. All of these patients were on the operating table no longer than thirty minutes. Anterior and posterior plaster shells were prepared previous to day of operation. These operations are performed by two teams, one, preparing the graft bed in the spine, the other, preparing the graft.

3. *Convalescence.* All the cited cases healed by primary union. The convalescent period was unusually rapid as compared to that in other spinal conditions. The patient in Case I, whose occupation was that of counterman, consisting of long standing, bending and lifting, returned to his usual work four months after the operation. Case II, a younger man, returned to his strenuous job as truckman three months after the operation. Case III, a policeman, proved very interesting on account of our inability to control him postoperatively. Three days after operation we found that patient sitting up in bed. At the end of four weeks, being entirely without symptoms, he was allowed to leave the bed with the aid of a Knight spinal brace. At the end of ten weeks, he returned to his regular patrol duties. Case IV, the youngest patient, was up and about within eight weeks. The patient in Case V, because of long duration of infection prior to operation remained in the hospital for two months. The brace was discarded six months after operation. She married and became a mother within two years after operation. This is a different picture than one finds in tuberculosis of the spine, even after spinal fusion.

When these convalescent facts are compared with the general experience of transversectomy and drainage, we are particularly impressed with the great comparative difference. There has been no evidence in any of these cases of relapses or recurrences. It is to be noted that all of

these patients have shown a rapid gain in weight following the operation.

4. *Rapid Regeneration.* The reparative processes, as shown by the x-rays taken postoperatively, demonstrate in a practical way what many in their writings have shown experimentally. (Gallie and Robertson¹⁰ and Leriche and Policard.¹¹) Apparently, the final course of disease is not only favorably influenced by the direct effect of complete immobilization, but from the experimental work of the above quoted authors one gains the information that the graft also establishes an increased blood supply, and, therefore, increased cellular nutrition. With this increased blood supply brought about by the extension of newly formed blood vessels, there occurs not only the introduction of immunizing factors to combat the infection but also the osteogenetic factors which influence more rapid regeneration. Bony coalescence of the affected bodies is noted in Cases I, II, III, and V, which showed marked bony destruction prior to operation. In Case IV, one notes that previous to operation the x-rays showed an irregularity and erosion of the lower articular margin of the second lumbar and the upper articular margin of the third lumbar vertebra. Six months after operation, there is present a re-establishment of the normal markings of both articular ends. (Fig. 18.) The only evidence remaining of the disease is a comparative narrowing of the intervertebral space. Due to the new bone formation all pre-existing evidences of buckling deformities are markedly diminished in our cases. A further interesting observation in these cases is that the grafts in all cases have practically retained their original size with distinct continuity of the trabeculae from the graft to the spinous processes.

5. *Fate of the Abscess.* Frequently, repeated x-ray examinations showed a rapid retrogression of the existing abscess formation in our cases. The previously existing evidences of mediastinal widening noted in the original x-rays of the first three cases cited is at present not discernable. Numer-

ous reports are present in the literature of the slow disappearance of abscess formation accompanying tuberculosis of the spine. In comparison, the abscess formation noted in our study disappeared more rapidly than the tuberculous abscess, probably, because in the former, no peri-inflammatory fibrosis sufficiently dense to prevent absorption has had a chance to form. The fate of this mediastinal involvement has been a subject of interesting study. While no biopsy studies are available in our cases nor any experimental data, which is exactly comparable to the events noted in the resolution of the apparent mediastinal inflammatory lesions, the factors involved can be discussed with a considerable degree of certainty.

As was pointed out earlier, the blood vessels in the vertebral bodies are especially rich in histiocytic cells lying in rather close relation to the lining endothelial wall. Furthermore, the point of intimate almost unified connection of periosteum to cortex was stressed. These two factors make available a rich blood supply and a large supply of phagocytic cells, easily mobilized, and close to the site of inflammation. It apparently requires only a rest factor to overbalance the recurring destruction of these phagocytes in the continuing inflammation in favor of resorption. This is supplied by the simple rest obtained in a plaster jacket or frame, but is apparently far more efficaciously performed by the bone transplant. The bone transplant by its power of fixation, produces a freedom from the progressing destruction caused by the continuation of the immobility of the vertebral segments.

The graft also acts by increasing local vascularity (phenomena of inflammation) by virtue of its continuous mildly irritative influences. In the light of the studies by Besredka,¹² such an influence heightens the local immune factors chiefly by the development *in loco* of defensive enzymatic immune bodies (cytolytic ferments). Menken,¹³ further showed that a large part in the elaboration of such bodies is played by

the histiocytic cells and that in turn, the growth of such cells is accentuated by the continuous sterile inflammatory factors (mild continuing trauma). According to Rich,¹⁴ the increased flow of fluid from the blood vessels into the surrounding tissues during inflammation serve the beneficial purpose of diluting and so rendering less irrigating any injurious substances liberated by infecting bacteria.

In addition to this diluent effect, the fluid that exudes contains specific neutralizing antitoxins and antibodies which cause local fixation and destruction of the infecting organisms. The presence of this continuing inflammation causes an increased flow of lymph from the affected area, thus flushing the site and irritating products of cellular destruction are washed away by a moving stream of the fluid. It is further confirmed by numerous other workers, Field, Drinker and White,¹⁵ Bezanion and Labbe¹⁶ and Menkin and Freund,¹⁷ that at the height of inflammatory reaction produced by even sterile irritants the lymph draining from these areas contains many polymorphonuclear leukocyte cells which are not present in normal lymph. For our purpose we can conclude that all above mentioned factors give rise to resorption of the already formed inflammatory products, and in the cases presented make for the disappearance of the abscess.

General Comment. In this study both in the review of the literature and the clinical progress of our cases, one is strongly impressed with the value of correlated analyses of pathological, bacteriologic and immunologic interrelationship in the practice of the surgeon who is frequently confronted with the problems of infection. In this study, we have gleaned many facts of the why and wherefore in the utilization of local tissue reactions especially as it applies to the resolution of invaded areas that subside without surgical intervention. It offers an explanation in regard to the rationality of present conservative therapeutic status of acute osteomyelitis. In it we also find why many cases of primary

suturing in both osteomyelitis and in compound fractures have succeeded.

CASE REPORTS

CASE 1. B. R., age forty-five, a white male, was suddenly seized with chills, fever and general malaise on March 1, 1930. Four days later he developed generalized joint pains of the upper extremity and the back and was treated for arthritis for three weeks by rest in bed and medication. He then developed a swelling near the right shoulder, which was diagnosed as an acute osteomyelitis of the right clavicle. The patient was removed to a hospital where an operation was performed consisting of incision, curettement and drainage. A culture taken at the time of operation proved to be a *Staphylococcus aureus*. At the end of two weeks he was discharged from this hospital. One month after this operation with clavicular wound still draining, the patient began to experience severe pain in the interscapular region. This pain gradually became worse and caused the patient to again become bedridden for six weeks. He was then advised to go to Mt. Clemens for his rheumatism of the spine; he remained there for six weeks becoming progressively worse with increasing pain, frequent chills, profuse sweating and loss of weight. Finally, he was seen by Dr. S. Klein, of Detroit, who told him that he was suffering from an infectious spondylitis. A high plaster body cast was applied giving the patient sufficient relief to be enabled to return to his home. Through the courtesy of Dr. Klein, he was referred to us for further care.

When first seen at our office the patient still presented signs of sepsis and complained of severe pain in his back. The cast was bivalved and examination showed a localized swelling and point of tenderness over the eighth and ninth dorsal segments. Motion of entire spine was markedly limited on account of pain. X-ray taken at that time showed a degeneration of the adjacent surfaces of the eighth and ninth dorsal vertebrae with the presence of bony proliferation. *Diagnosis:* Osteomyelitis affecting the eighth and ninth dorsal vertebrae. The patient was admitted to the Jewish Hospital of Brooklyn, August 13, 1930.

On admission his temperature was 100.4°C.; pulse, 120; respiration, 26. He had had frequent attacks of renal colic for fifteen years. His last attack occurred eighteen months previ-

ously, when he was treated by crushing through a cystoscope. Other tracts were normal.

Physical examination revealed an adult, well developed male, who coughed from time to time and appeared anxious and sick. The patient presented a chronic septic appearance, was markedly cyanotic and dyspneic. The cough was accompanied by very little expectoration, but there was marked hoarseness. The left pupil was irregular and drawn to one side due to injury during childhood. There was a scar over the outer half of the right clavicle reaching to the shoulder, marked induration of the right clavicle, no tenderness and no palpable glands. The heart was not enlarged. There were sounds of valvular quality at the apex and no murmurs nor irregularities. Percussion showed slight dullness in the right apex anteriorly due to callosity of clavicle. Breath sounds were harsh over right scapular, apical and infraclavicular regions, as compared to similar areas in opposite side. Coarse ronchi and transmitted tracheal rales were heard throughout. Impression: chronic bronchitis and tracheitis.

There was limitation of spinal motions especially in the dorsal region. Pain was present on forward flexion of cervical region and increased heat sensation in the lower dorsal region. There was marked tenderness over areas corresponding to eighth, ninth and tenth dorsal vertebrae and moderately increased dorsal kyphosis with moderate gibbous formation at the level of the eighth dorsal vertebra.

Red blood count was 4,740,000; hemoglobin, 85 per cent; white blood count, 12,600; polymorphonuclears, 76 per cent. Urine on two examinations was negative except for a few white blood cells. Sputum on three examinations showed no elastic tissue and no T.B.C. Blood pressure, 130/84; blood culture, negative.

X-ray examination, August 14, 1930, showed marked narrowing and irregularity of the eighth and ninth dorsal vertebrae. The interspace, however, appeared intact and no wedge-shaped appearance was observed. The proliferation of bone to a slight degree was noted. A surrounding opacity obtained, suspicious of a radio-opaque abscess. In view of the clinical findings and the history of bone infection in another part of the body, one must look upon these findings as infectious (osteomyelitis). (Figs. 1 and 2.)

The patient was kept in bed for a week and suitable medical treatment given for his

bronchial condition. During this period a bivalved body cast was prepared for postoperative care.

taken at that time are shown in Figures 3 and 4.

CASE II. M. R., age twenty-one, a male,



FIG. 1.

FIG. 2.

FIGS. 1 AND 2. CASE I. Anteroposterior and lateral views, showing narrowing irregular destruction of articular ends between eighth and ninth dorsal vertebrae; large surrounding opacity indicating mediastinal abscess.

On August 22, 1930, a fusion of spine was performed according to the Albee technic, employing a heavy crest graft from the left tibia, six inches long and inserted into the split and denuded spinous processes of the sixth, seventh, eighth, ninth, tenth and eleventh dorsal vertebrae.

Convalescence was uneventful and the patient's general condition good throughout. Temperature, pulse and respirations were practically normal throughout. There were no complaints referable to local spinal condition. The wounds of back and leg healed readily. The patient was kept in bed for six weeks, during which time he was fitted with a Knight-Taylor spinal brace and allowed out of bed wearing this support. He began to walk at first with the aid of crutches and was discharged from the hospital, October 18. He was sent to a convalescent home for several weeks.

In January, 1931, he discarded the brace and returned to work as a counterman. Outside of an occasional attack of bronchitis, the patient has had no pain in back or chest since discharge. He was last seen for check-up on January 12, 1939, nine years after the operation. There has been no recurrence except for an attack of renal colic (right side) three years ago. He has been continuously at work and has gained over sixty pounds in weight. X-rays

white truck driver, was confined to bed with a cold and pains in the chest four weeks prior to admission. He remained at home for about a week and then returned to his work feeling very weak. Six days previous to admission, he began to experience severe sticking pains in the right chest radiating to the right axilla. These pains were aggravated by deep breathing and coughing. On the following day, he became very feverish and subsequently began to experience severe headaches. Two days before admission he noted that his neck and back became stiff and he had great difficulty in turning. The patient was admitted to the Medical Service of the Beth-El Hospital, May 26, 1931. On admission, his temperature was 104°F., pulse 100, respiration 22.

Physical examination revealed a young white male, twenty years old, acutely ill. Sternomastoids were very tender to pressure. His head could be rotated from side to side with pain. There was rigidity of the neck and pain on attempt to flex head. A slightly palpable thyroid was present. The following were also found: Slight lag in right lower chest; no change in tactile fremitus; good resonant note throughout except in the upper right axilla and also slight impairment in the right base posteriorly; no friction rub or rales; breath sounds clear in right axilla posteriorly. Breath sounds were

suppressed in right base. The heart was not enlarged. Sounds were of good quality, regular in rate and rhythm. No murmurs were present.

During the first four weeks he ran a temperature ranging between 102 and 104°F. then an irregular one between 99 and 101°F., reach-



FIG. 3.



FIG. 4.

FIGS. 3 AND 4. Case 1. Anteroposterior and lateral views taken nine years later showing complete bony coalescence of eighth and ninth vertebrae with disappearance of mediastinal widening.

The abdomen showed slight general spasticity and no tenderness. No organs or masses were felt. Back examination revealed no evident signs of deformity, but there was marked rigidity of the entire spine. Marked tenderness was localized to the region of the seventh and eighth dorsal vertebrae. The extremities showed no purpuric spots. Patellar reflexes were not obtainable. The Kernig reflex was present and explained on account of the existing generalized myalgia. No Babinski nor Oppenheim reflexes were present and no sensory or motor disturbances were noted in both upper and lower extremities. There was generalized myalgia with severe pain on pressure of almost any muscle in body.

Laboratory findings were as follows: Urine examinations (18 specimens)—in one specimen a trace of albumin was found, otherwise there were no abnormal findings. Blood: White count ranged from 20,600 to 10,000; polymorphonuclears ranged between 84 and 76; glucose 118, urea N. 14.2, creat. $\frac{1}{57}$; cultures were sterile three successive times; the Widal test was negative, repeated four times. Cerebrospinal fluid—Clear, albumin +, globulin +, sugar reduction + + +, cell count 2 to 15 per field (lymphocytes), no T.B.C. Culture was sterile. Feces—no typhoid bacilli found.

ing 103° on two different occasions up to date of operation which was eight weeks after admission. During this time, repeated x-rays were taken of chest showing definite hilum opacity on right side consistent with central pneumonia. The cerebral spinal fluid was examined several times because of a suspicion of tuberculous meningitis. The medical opinion was of a central pneumonia with meningismus. On September 13, four months after admission to hospital, the patient was first seen by us on account of rigidity of back and persistent complaint of pain in this region.

The patient was lying in an opisthotonus position. Examination at first was very difficult on account of extreme pain even when bed clothes were touched. A gibbous deformity was noted in the region of the eighth dorsal vertebra and there was marked tenderness over that point. The soft tissues surrounding showed evidence of infiltration. A portable x-ray was taken of the dorsal region which showed a narrowing of the seventh and eighth dorsal vertebrae with evidence of bony proliferation anteriorly and of abscess formation anterior to the spine.

The patient was placed on a Bradford frame which apparently gave some symptomatic relief at times, but he was very difficult to handle. Agonizing pain persisted especially when the

patient was touched or moved. Another x-ray taken two months later was reported as follows: "There are destructive changes involving the

Operation was performed October 21, 1931, consisting of a spinal fusion, according to the Albee technic. There was no postoperative

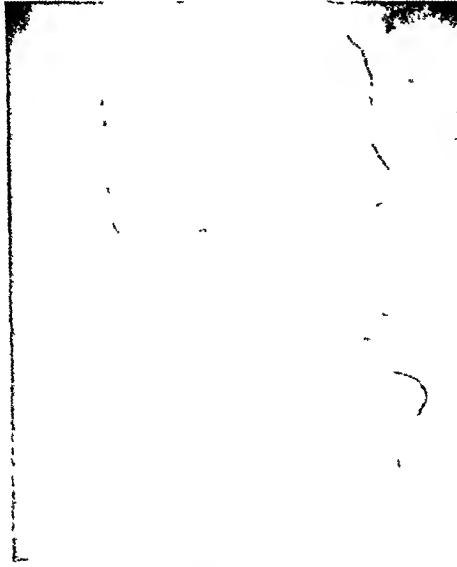


FIG. 5.

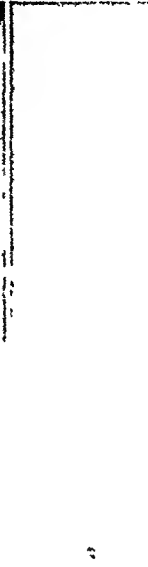


FIG. 6.

FIGS. 5 AND 6. Case II. Anteroposterior and lateral views showing destructive changes involving seventh, eighth and ninth dorsal vertebrae; eighth completely involved; marked mediastinal widening.



FIG. 7.



FIG. 8.

FIGS. 7 AND 8. Case II. (Taken eight years after.) Anteroposterior and lateral views showing coalescence of vertebral bodies; disappearance of mediastinal opacity.

bodies and articular surfaces of the 7th, 8th and 9th dorsal vertebrae. The 8th dorsal vertebrae is almost completely destroyed. There is a soft tissue shadow embracing the spinal column in the involved region (paravertebral collection)." (Figs. 5 and 6.)

In comparing the above x-ray reports, there is noted a distinct increase in the destructive process despite the patient's fixation on the Bradford frame.

reaction. One week following operation, the temperature reached normal for the first time and remained so throughout his stay in the hospital until December 16, 1931 when the patient was discharged wearing a Knight-Taylor brace, walking around comfortably.

Two months after discharge from the hospital, the patient reported that he was back at work driving a truck. He discarded the brace because it interfered with his work and was

free of any symptoms. Patient was seen at our office January 17, 1939, at our request. Check-up examination showed perfect healing at site of operation eight years after operation. X-rays show definite coalescence of seventh, eighth and ninth dorsal vertebrae. No mediastinal widening was noted. (Figs. 7 and 8.) He has had no symptoms or complaints of any kind referable to his back.

CASE III. A. J. D., age twenty-six, a white male, suddenly experienced pain in the right iliac region on September 9, 1932. He attributed the pain to a strain produced by stopping a runaway horse one day previous. The patient was taken to Cumberland Hospital, Brooklyn, where an operation was performed for appendicitis. Report of pathological findings of the operation from the records of said hospital showed an obliterative appendix with peri-appendicitis. Peritoneal drainage was employed. Three days postoperatively while being turned he experienced a sharp pain in the lower thoracic spine. The patient remained in bed for twenty-six days. When leaving the bed the back pains recurred. He remained in the hospital for six weeks. X-rays of chest were examined for any spinal pathological condition but none were noted. The day after his discharge from the hospital, he was re-admitted to another hospital because of a severe attack of left chest pains and a rise in temperature. In the records of the Greenpoint Hospital, we find the admission diagnosis reading, "Left apical pneumonia, subhepatic abscess and bilateral pleuritis." These diagnoses were not confirmed by laboratory or roentgenological examinations. After running a febrile course for about four weeks, the temperature finally subsided and after being afebrile for a week he was discharged. Upon discharge the patient still complained of pain and stiffness of the back.

On January 6, 1933, three days after discharge from Greenpoint Hospital, the patient experienced an acute, severe, sharp pain in the right lower quadrant which became progressively severe until the pains became intolerable. Pain described as agonizing, severe, sharp, knife-like, seemed to pass through to the back; there was no radiation to thigh or penis. He vomited twice and was then admitted to the Urological Service of The Jewish Hospital, Brooklyn.

On admission his temperature was 99.6°F.,

pulse 96, respiration 22. Physical examination generally was irrelevant and negative. Abdomen revealed a scar (right pararectus), tenderness on deep pressure in the right lower quadrant two inches lateral to the scar. Rectal examination was negative.

Surgical Consultation: Flaccid abdomen, no spasticity, rigidity or tenderness. Impression: surgically—negative. Right nephrolithiasis was suspected. Cystoscopy and intravenous pyelography did not confirm diagnosis. There were no areas of hyperesthesia or anesthesia, but there were bilateral clonus, questionable Babinski, protective fixation of muscles of the spine, and voluntary movements were performed with difficulty. There was marked limitation of motion of the spine in the entire dorsal region with buckling of the eighth dorsal vertebra, localized spinal muscle spasticity, no thermal changes over point of pathology and no evidence of muscular atrophy in the lower extremities.

Impression: Osteomyelitis of the middorsal vertebra. A Bradford frame was advised.

The only evidence of possible cord involvement was the inexhaustible ankle clonus. There was no evidence of a segmental lesion. There was indefinite hyperalgesia over the back and abdomen D7 to L2, which was most marked in the region of D8 and tenderness over D8 vertebra. Sensory changes and decreased motor power of the spinal muscles suggested radiculitis.

X-rays taken on September 10, 1933, showed both kidneys normal except for a small opaque shadow in the left lumbar region apparently cast by calculus in the lower calyx of kidney. This shadow persisted in all renal plates. Pulmonary study revealed bilateral hilum infiltration with no evidence of localized pathology. The cardiac shadow was within normal limits of size, shape and position. X-rays on January 12, 1933, showed evidence of a destructive process of the body of the eighth dorsal vertebra. The intervertebral spaces were not involved and there was a suggestion of degeneration of the anterior portion of the body which had partially collapsed but not completely so. A metastatic osteomyelitic process might readily account for these findings. This conclusion was favored rather than Koch or neoplasm. X-rays on January 28, 1933, confirmed previous report. Further, the intervertebral space below, however, was definitely involved as was the upper portion of the

adjacent vertebral segment. One did not note the characteristic rarefaction that is usually observed with tuberculosis, but the findings

believe the process to be of an osteomyelitic nature. (Figs. 9 and 10.)

Urine on admission showed 1 plus albumin;

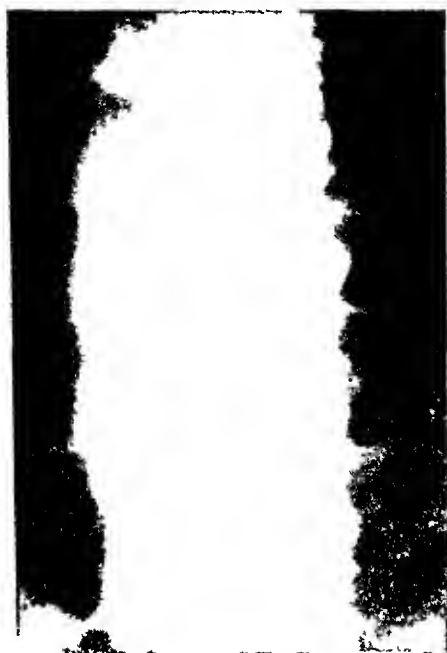


FIG. 9.



FIG. 10.

FIGS. 9 AND 10. Case III. Anteroposterior and lateral views show destructive involvements of eighth dorsal vertebra with secondary degenerative process of contiguous vertebrae seventh and ninth; definite mediastinal widening.



FIG. 11.

FIG. 12.

FIGS. 11 AND 12. Case III. Anteroposterior and lateral views showing complete ankylosis of seventh, eighth and ninth vertebrae; mediastinal widening diminished.

would otherwise fit in with same. Opinion was uncertain as to whether this was tuberculosis or secondary osteomyelitis, but in view of the involvement of the contiguous vertebrae, indicating a rapid progression, we were inclined to

5 to 10 red blood cells hpf., occasional white blood cells and crystals. On repeated examinations these pathological elements were not observed. Blood chemistry was normal; Wassermann and Kahn tests were negative. White

blood cells, 13,650 and 14,000; polymorphonuclears 89 per cent on admission, 82 per cent later; blood culture was sterile.

The patient was accepted on the Orthopedic Service on January 20, 1933. He was placed on a Bradford frame with head traction. On February 6, 1933, an Albee spine fusion was performed under gas-oxygen ether anesthesia with a six inch graft from the right tibia inserted between D5 and D11. Immediate reaction was good. For several days postoperatively the temperature curve was markedly irregular. He developed a respiratory infection and four days later the temperature returned to a flat normal level. On March 15, 1933, a spine brace was applied. Wounds healed per primam. The patient was discharged on March 16, 1933, markedly improved and was referred to the out-patient department for follow-up. He was seen several times in the out-patient department and his condition was found to be excellent.

The patient returned to his regular duty as patrolman on May 1, 1933, or less than three months postoperatively. His general condition was very good. He discarded his brace when he returned to duty as he had absolutely no symptoms. He has gained 54 pounds since the operation and has had no signs or symptoms of recurrence, except for pain at the point of incision during inclement weather. On December 18, 1938, x-rays showed complete coalescence between the eighth and ninth dorsal vertebrae, the graft in situ and no evidence of mediastinal widening. (Figs. 11 and 12.)

CASE IV. L. D., aged 14, Italian school boy, was admitted to the medical service on September 11, 1933, complaining of pain in the lower part of the spine for nine days and fever for eight days' duration.

Three weeks prior to admission the patient had a mild cold associated with cough and expectoration but remained ambulatory. Nine days prior to admission he developed severe pain in the lower part of the back which was aggravated on walking. The following day he was compelled to go to bed. His temperature rose to 100.6°F. and thereafter maintained a level between 103 and 104°F. Pain occurred in the lower part of the back, sometimes excruciating, radiating anteriorly to the abdomen; it was aggravated by coughing and straining at stool. On the night of admission he developed severe paroxysms of coughing and cramp-like

pain in lower portion of his back. He vomited once since the onset of illness. There were no subjective neurological symptoms, no trauma, no urinary difficulties and no rheumatic manifestations.

He had had diphtheria at seven, asthma at nine, a sore throat once a year and cervical adenitis three years previous.

On admission his temperature was 101.2°F., pulse 98, respiration 24. He was a well developed boy, flushed, acutely ill, holding the left side of his abdomen. There were no respiratory difficulties. Two maculopapules were on the skin of the thorax. Pupils reacted to light and accommodation; extra-ocular movements were good; nasal and pharyngeal mucosae were congested; there was moderate tonsillar adnopathy but no nuchal rigidity. Flexion of spine elicited low spinal pain. Lungs and heart were normal, abdomen voluntarily rigid and no direct tenderness or rebound tenderness.

The entire spine was held rigid especially over the lumbar region with no flexion or lateral motion. There was tenderness of second and third lumbar vertebrae and in surrounding musculature, tenderness and limited motion in internal rotation of right thigh, and no sacroiliac pain. There was a suggestion of Kernig reaction with diminution of knee jerks bilaterally. The spine showed a kyphotic state extending from the tenth dorsal to fourth lumbar. Flexion and extension of the spine in the lumbar region was markedly limited on account of muscular rigidity, which was palpated on either side of the spine. Marked tenderness was located over the second lumbar vertebra. The patient presented a bilateral psoas spasticity with resultant limitation of hip extension. There was a suspicion of infectious arthritis or osteomyelitis of the second lumbar vertebra.

An x-ray on September 14, 1933, of the dorsal and lumbar spines was negative. (Fig. 13.) An x-ray on October 7, 1933, showed a narrowing of the intervertebral space between the second and third lumbar vertebrae, and beginning erosion of the upper margin of the third lumbar vertebra. (Fig. 14.) An x-ray on October 16, 1933, showed the narrowing of the intervertebral space to be more marked, an increase of the rarified area of the upper part of the third lumbar vertebra, and beginning signs of necrosis in the lower border of the second lumbar vertebra. (Fig. 15.) Five days later an x-ray showed advancement in the degree of

narrowing of intervertebral disc and increasing signs of necrosis of the articular margins. (Fig. 16.)

Staphylococcus aureus, in broth only. Bacteriology: No agglutination *B. typhosus*, para A and para B; urine and stool showed no *B. typhosus*.



FIG. 13.



FIG. 14.

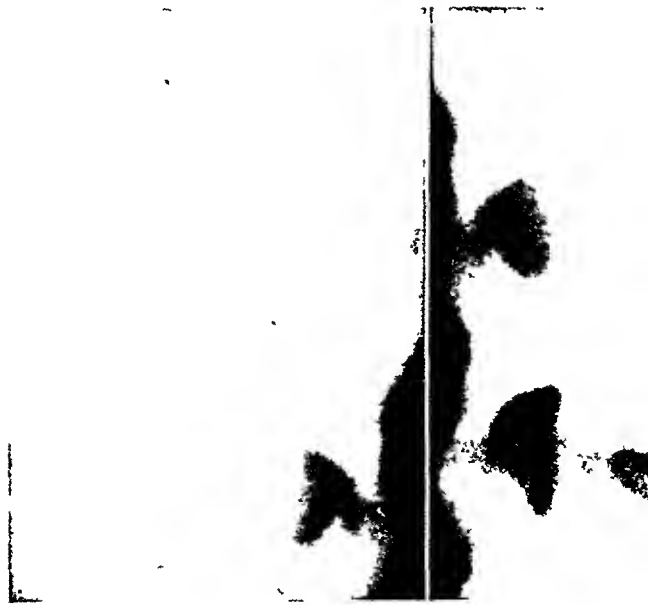


FIG. 15.

FIG. 16.

FIGS. 13, 14, 15 AND 16. Case IV. Lateral views taken within a period of one month and showing advancing processes of degeneration affecting second and third lumbar vertebrae.

Laboratory examination revealed the following: Urine: several specimens showed no unusual elements; blood on admission: white blood cells, 25,000; 86 per cent polymorphonuclears; preoperative blood: white blood cells, 9,600; 81 per cent polymorphonuclears; red blood cells, 4,700,000; 75 per cent sahli; chemistry: normal; Wassermann and Kahn tests: negative; culture: nine-twelfths, *Staphylococcus aureus*, 100 col.; nine-fifteenths, *Staph-*

Spinal fluid: Bloody fluid, sterile culture, no organism; Wassermann and Kahn tests: negative. Old tuberculin skin test: 0.1 mg. negative; 1.0 mg. and repeat suspicious.

Five days after admission the patient became more comfortable. T.P.R. were within normal limits, but symptoms persisted to a lesser degree. On October 7, the patient was accepted on the Orthopedic Service and was maintained on a Bradford frame for fourteen days.

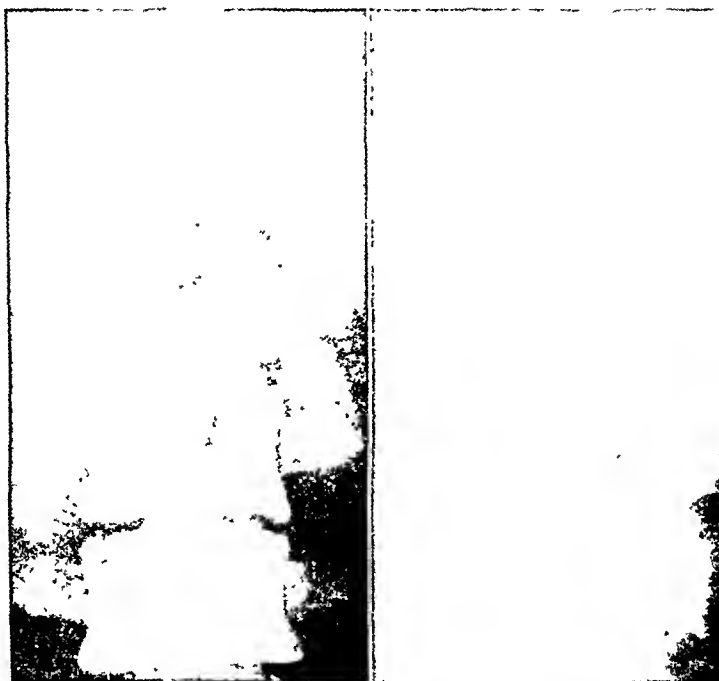


FIG. 17.

FIG. 18.

FIGS. 17 AND 18. Case IV. Anteroposterior and lateral views showing complete regeneration of bony erosions. Only a slight narrowing of intravertebral space remains.



FIG. 19.

FIG. 20.

FIGS. 19 AND 20. Case V. Anteroposterior and lateral views taken six months prior to operation showing loss of cortical substance on inferior portion of body of second lumbar vertebra. On right side note a beak-like new bone formation.

On October 23, under gas-oxygen-ether anesthesia, an Albee spine fusion was performed with a six inch graft from the left tibia inserted between D12 and L5 and the patient was placed in a body cast previously prepared.

Postoperative reaction was good. Leg and back wounds healed per primam. On December 4, a back brace was applied and the patient was permitted out of bed. He was discharged December 6, 1933, and referred to a convalescent home. He is seen regularly in the outpatient department; he is ambulatory and still wearing brace; his condition good.

X-rays taken of the lumbar-spine December 29, 1933, show upper articular margin of the third lumbar and lower articular margin of the second intact in outline. Brace was removed. The only existing evidence as shown on the last plate is the intervertebral narrowing which appears less marked now than previous to operation.

At the last examination, December 17, 1938, the patient was very well; he had had no symptoms or disability since discharge and has been attending school regularly. Objectively, he showed a really normal back except for operative scar. X-rays taken the same day show a very slight narrowing between the second and third lumbar vertebrae. Articular margins are regular and distinct. (Figs. 17 and 18.)

CASE V. M. R., age twenty-one, female, white, was admitted to Beth-El Hospital, December 22, 1934. Three months before admission while attempting to sit down, the chair pulled away and the patient fell to floor. Developed pain in the lower part of her back which cleared up within a few days. Two months before admission the pain returned with severe intensity. This pain started in the right lumbar region and later began to radiate anteriorly to the inguinal region and right hip. Pain became increasingly worse at night preventing sleep. She had her back strapped and then wore a plaster corset which aggravated pain. The patient's past history was irrelevant; she had had no other sickness except those of childhood. Temperature on admission was 99.8°F., pulse 116, respiration 22.

Physical examination revealed a very well developed, white female, not acutely ill and all other tracts essentially negative. The patient was unable to sit up without aid. There was marked tenderness over the second and third lumbar vertebrae and bilateral erector

spinae spasm. Motions were restricted in all directions especially in hyperextension of the lumbar spine. Straight leg raising was markedly restricted bilaterally; hyperextension of hips produced pain in the lumbar spine and marked bilateral psoas spasm was present.

Blood count: Red blood cells, 4,400,000; hemoglobin, 85 per cent; leukocytes, 9,100; polymorphonuclears, 76 per cent. Urine was negative.

X-rays taken on December 22, 1934, showed a loss of cortical outline on the inferior portion of the body of the second lumbar vertebra. On the right side of the body one noted a beak-like new bone formation. Impression: Low grade osteomyelitis or tuberculosis. (Figs. 19 and 20.)

A body jacket was applied on December 28, 1934. During this stay in the hospital the patient ran a low grade temperature with few nocturnal rises to 101°F. She was advised operation because a subsequent x-ray taken February 8, 1935, showed greater amount of bone erosion and increased narrowing of the intervertebral space between the second and third lumbar vertebrae. Operation was refused by the family. A Knight spinal brace was applied and the patient taken to Florida on March 6, 1935. She returned in four weeks and reported to our office. A definite buckling was noted with exacerbation of clinical symptoms. Operation was again advised. After few consultations with various men in New York and Brooklyn, the patient returned to my care and was re-admitted to Beth-El Hospital on April 28, 1935. X-rays taken April 30, 1935, showed an absence of bony substance of the posterior and inferior one-half of the body of the second lumbar vertebra, right side and extending into articulation. There was a well defined proliferative bony area about this rarefaction and a marked narrowing of the interspace between the second and third lumbar vertebrae. There was also noted a thinning of the inferior portion of the left side of the second lumbar body with some evidence of periosteal reaction. X-rays taken of chest showed no evidence of parenchyma infiltration nor pleural involvement. (Figs. 21 and 22.)

Operation was performed on May 3, 1935, under general anesthesia. An Albee spinal fusion was performed. The postoperative reaction was good and convalescence was uneventful. Leg and back wounds healed per primam. She was discharged on July 8, 1935.

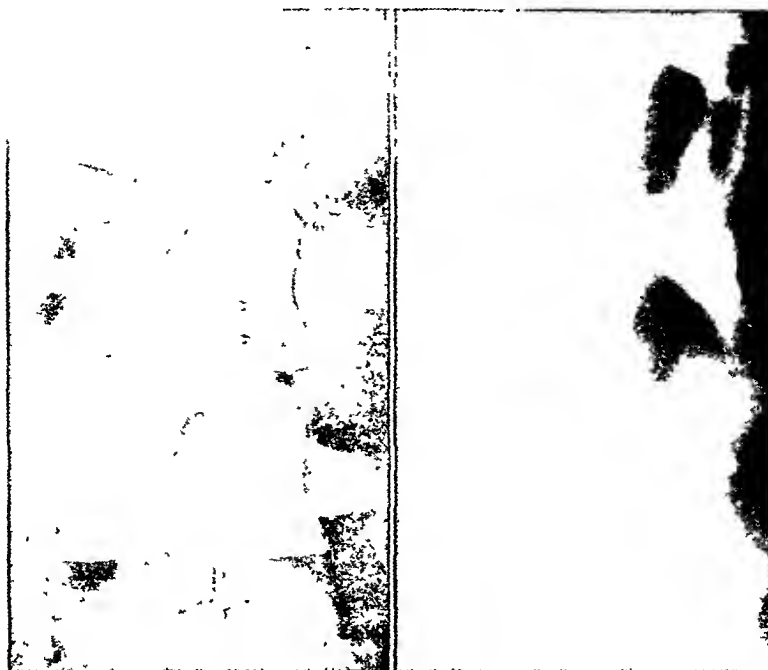


FIG. 21.

FIG. 22.

FIGS. 21 AND 22. Case v. Anteroposterior and lateral views taken prior to operation showing definite articular erosion of inferior surface second and superior surface third lumbar vertebrae; rapid advancing degeneration as compared to Figures 19 and 20.

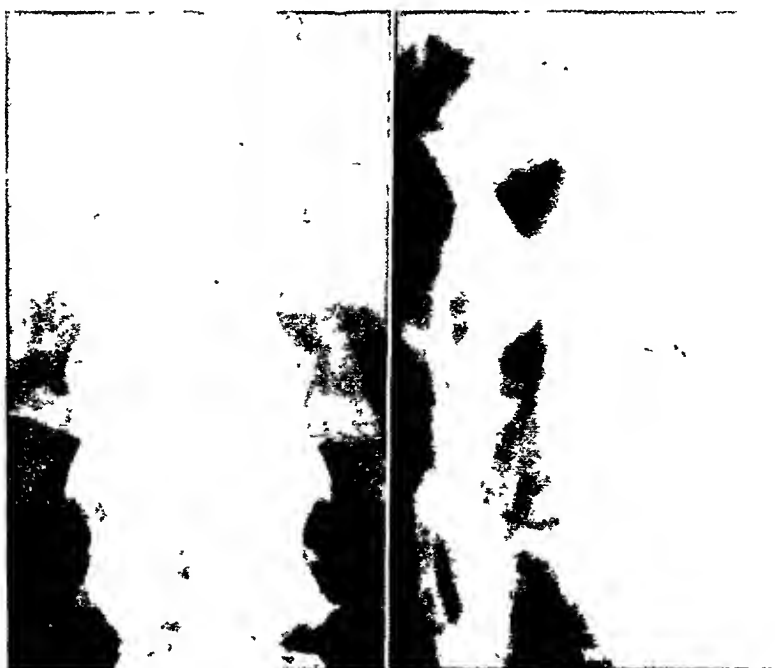


FIG. 23.

FIG. 24.

FIGS. 23 AND 24. Case v. Anteroposterior and lateral views taken one and one-half years after operation showing marked narrowing of interspaces between first and second and second and third lumbar vertebrae; texture of bone same as in uninvolved vertebra.

The patient wore a brace for three months following discharge from the hospital. The last x-rays taken on November 18, 1936, showed marked narrowing of the second lumbar vertebral body to one-half its original size. Articular margins were well outlined and regular and showed no evidence of the previously noted erosion. There was marked narrowing of the interspace between the second and third vertebrae. The density of the remaining portion of the body was definitely of the same texture as the bodies above and below. The graft was in situ. (Figs. 23 and 24.)

The patient married one year after her last discharge from the hospital. In February, 1938, I was requested to examine the patient in the Maternity Pavilion of the hospital after childbirth. She had a normal pregnancy and delivery of an 8 pound baby. She has had no symptoms referable to her back.

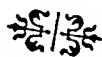
SUMMARY

1. Five cases of acute osteomyelitis of the spine, treated by tibial transplant fixation are reported. The clinical picture of the process is delineated, its differential diagnosis discussed and the radiographic picture presented.
2. The embryogenetic and anatomic factors in the production of the lesions are discussed. The vascular supply of the vertebral columns is discussed in detail because of its apparent intimate relationship with the processes of regeneration.
3. The rationale for spine fusion is presented by means of tibial bone graft. It is shown that the postoperative reactions are absent; that convalescence is far more rapid and complete than by other methods

of therapy; that bone regeneration in the affected vertebra is so rapid as to be concomitant with the immediate post-operative course. It is pointed out that prevertebral inflammatory processes radiographically demonstrated as abscesses or phlegmonous mediastinitis disappear without surgical drainage of the involved area. The probable factors in such retrogressive phenomena are discussed.

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EXTRUSION OF THE SMITH-PETERSEN NAIL IN INTRACAPSULAR FRACTURES OF THE NECK OF THE FEMUR*

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THE contributions of Smith-Petersen toward solving the problem of the unsolved intracapsular fracture of the

nized and appreciated. The so-called open method of fixation in which an arthrotomy is performed and the hip exposed by the



FIG. 1. S. M., intracapsular, midcervical fracture of neck of left femur.

neck of the femur have received general and well merited recognition. His work ushered in a new era in the treatment of patients with intracapsular fractures who were previously doomed to a life of recumbency, disability and suffering. The method of internal fixation, which he advocated in 1931,¹ greatly shortens the period of treatment and hospitalization, and permits patients to leave their sick beds within a few days after operation. It eliminates the dangers attendant upon long periods of recumbency or immobilization in plaster and is thus applicable to patients who were considered unsuitable for the older methods of treatment.

But this method presents certain risks and difficulties which should be recog-

Smith-Petersen (iliofemoral) incision is a severe operation entailing an appreciable degree of shock. Because of the trauma involved in reflecting the gluteal muscles from the external surface of the ilium and the other steps necessary to obtain an adequate exposure, infection is not uncommon. It has also been observed that opening the capsule permits visual reduction and enables the surgeon to correct rotation of the head, the removal of interposed shreds of soft tissue, and the accurate introduction of the nail, but it renders apposition and maintenance of the fragments more difficult. In other words, reduction and maintenance are easier if the capsule is not opened. This has been explained by the compressing action of the

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capsule which acts like a rubber tube put on stretch when the lower extremity is abducted.

cases firm fixation is not accomplished; motion between the fragments occurs and nonunion is the usual end result. Plummer²

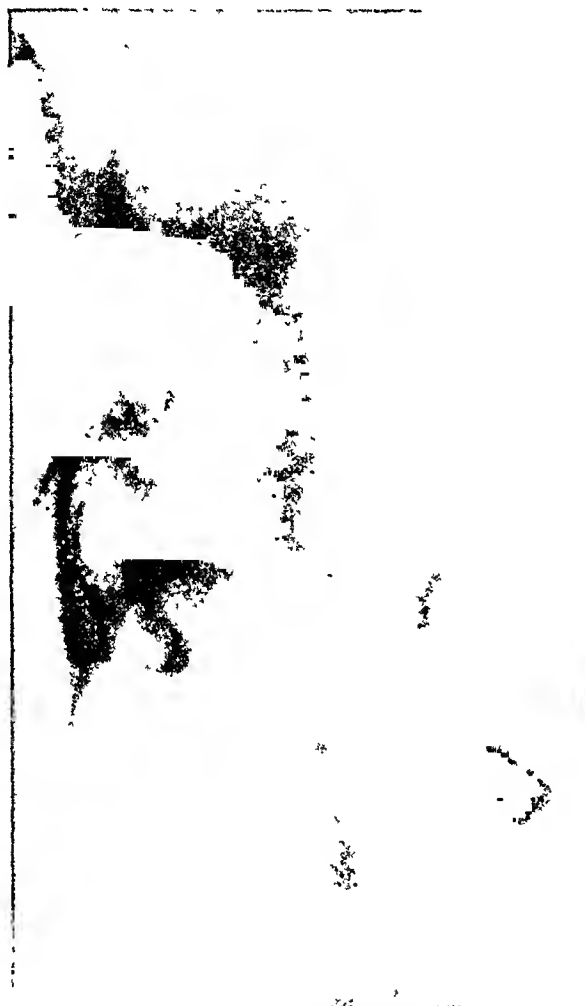


FIG. 2. S. M., anteroposterior view after reduction and insertion of Smith-Petersen nail.

The foregoing considerations have led most surgeons to abandon the open operation in favor of the so-called semi-open approach through a lateral incision. This latter method entails little shock or danger of infection and the operating time is short.

However, there are certain mechanical difficulties inherent in the use of a large flanged nail. In the first place if during the first attempt the nail is not accurately placed, subsequent attempts are very likely to fail. This is due to the inevitable destruction of cancellous bone while driving the nail. In making the subsequent attempts, the amount of bone destruction is increased and a large tunnel may be formed which will not grip the nail firmly. In such

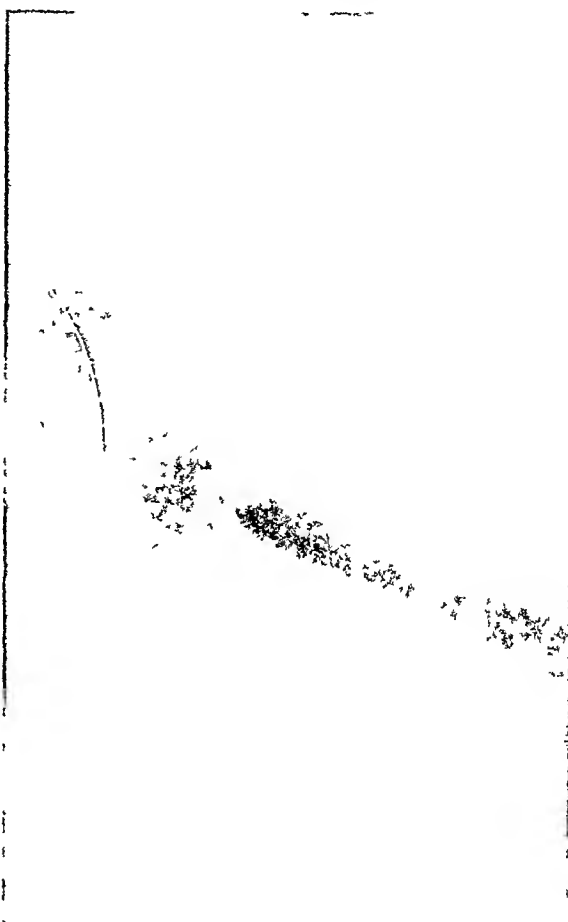


FIG. 3. S. M., lateral view showing nail in accurate position.

states: "In the majority of the younger patients, with good reduction and internal fixation, bony union can be expected. In the older patients, we probably must be satisfied with a satisfactory weight-bearing function and perhaps assume that the fixation nail will be the chief factor in maintaining a useful leg for these patients during the rest of their lives." If we accept this hypothesis, the necessity of firm fixation is apparent.

The second mechanical difficulty is inherent in the necessity of driving rather than drilling the nail. It is the writer's experience that drilling is more satisfactory than driving. Drilling is less likely to separate the fragments and gives a better grip.

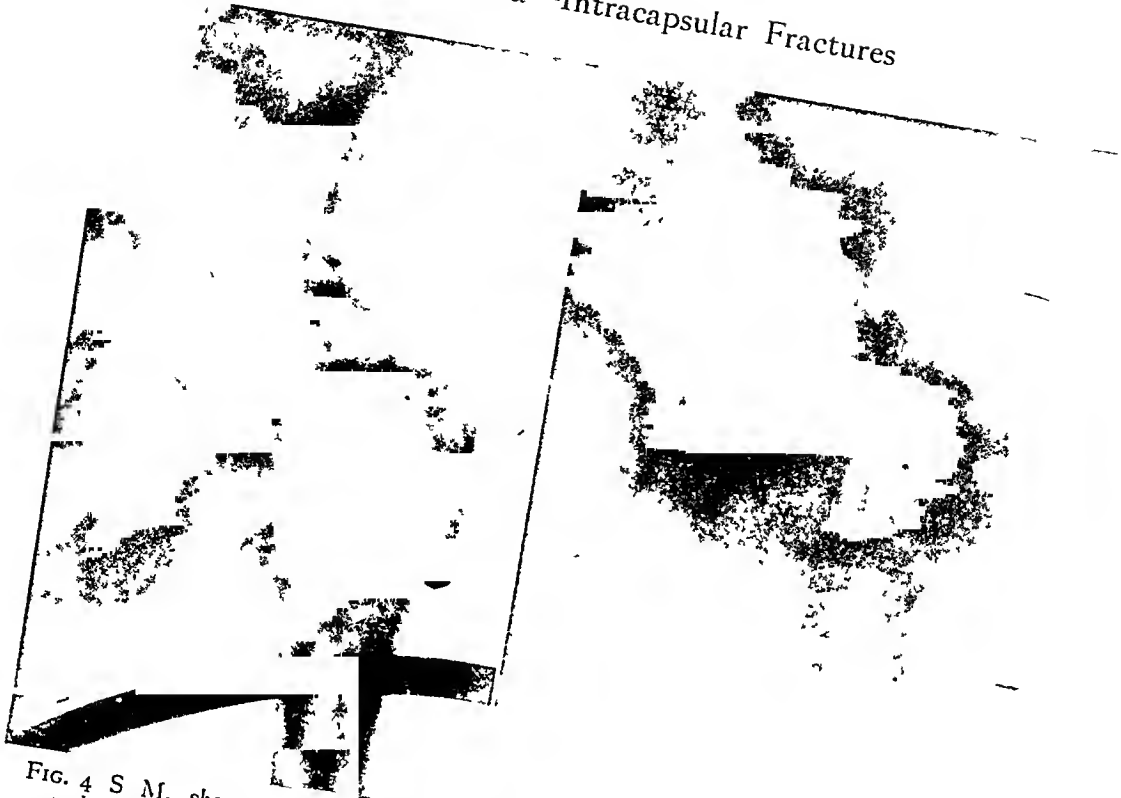


FIG. 4 S. M., shows extrusion of nail and refracture of neck about eleven months later.

FIG. 5. S. M., after McMurray osteotomy.



FIG. 6 F. P., intracapsular, mid-cervical fracture of neck of left femur.

FIG. 7. F. P., anteroposterior view after reduction and insertion of Smith-Petersen nail.

Finally, the Smith-Petersen nail lacks a sharp, penetrating point, and is, therefore, less likely to secure a firm hold on the

fractures, but also spiral, oblique and comminuted fractures. It is, therefore, just as difficult to maintain the position in a spiral

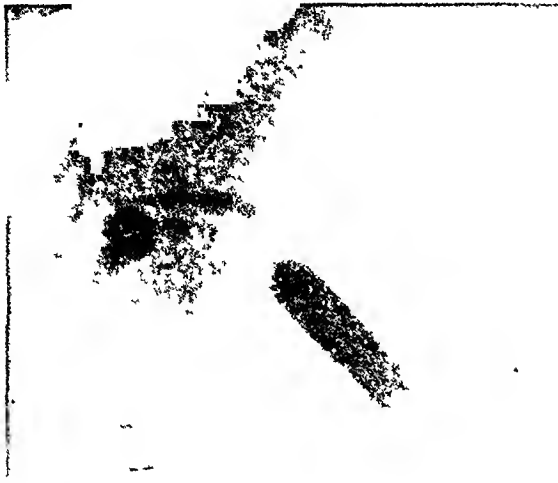


FIG. 8. F. P., shows extrusion of nail about five weeks later.

capital fragment. It has been observed while inserting the Smith-Petersen nail with the capsule opened, that as the point of the nail impinges against the capital fragment, hammering the head of the nail tended to separate the fragments rather than draw them together. To overcome this difficulty, hammering on the special impactor should alternate with hammering on the head of the nail until the nail is driven through the head. A few sharp blows on the impactor should always be delivered before closing the wound.

But firm impaction is not obtainable in all types of intracapsular fractures and the writer strongly believes that a further subdivision or classification of intracapsular fractures is greatly needed. There is little doubt that the position of the fracture line, its inclination, the presence and extent of comminution are important factors in determining the end result. Leadbetter³ states: "The type of fracture must also be considered for in fractures of the neck of the femur one sees not only transverse



FIG. 9. F. P., specimen removed at autopsy showing complete absorption of neck. Steinman pin shows position of Smith-Petersen nail

or comminuted fracture of the neck of the femur as in any other bone."

It may be helpful, whenever possible not to be satisfied with the diagnosis of an intracapsular fracture, and to further designate whether it is a subcapital, mid-cervical or basilar and to note the presence of comminution and the obliquity of the fracture line. If this is done, the varying end results reported may be more intelligently understood and evaluated. Plano-graphic x-rays may be of aid in furnishing better visualization. Our experience with subcapital and comminuted fractures has been disappointing, and some day we may be driven to the position of admitting defeat in these cases and performing an osteotomy at the outset. Telson⁴ classified twenty-five cases in which internal fixation was accomplished by the insertion of multiple steel wires and the subcapital variety gave the poorest end results.

Moore⁵ states: "The nearer a fracture is to the head, the poorer is the blood supply; this explains why subcapital fractures are more prone to non-union than are fractures through the base of the neck.

"Another factor of great importance is that mechanically it is more difficult to maintain apposition in a subcapital frac-

ture than it is in a basilar one. Healing of these fractures is governed by the rules of hyperemic decalcification and ischemic recalcification. When the fragments are imperfectly immobilized, the trauma of motion gives rise to increased and continued hyperemic decalcification with absorption of the neck and non-union. In subcapital fractures with non-union the neck is absorbed because the main source of blood supply comes up from the distal fragment and hyperemic decalcification takes place there. The head in such fractures may be almost entirely avascular; there is no absorption of its calcium content, and it shows up in the x-ray film as a dense hard sequestrum."

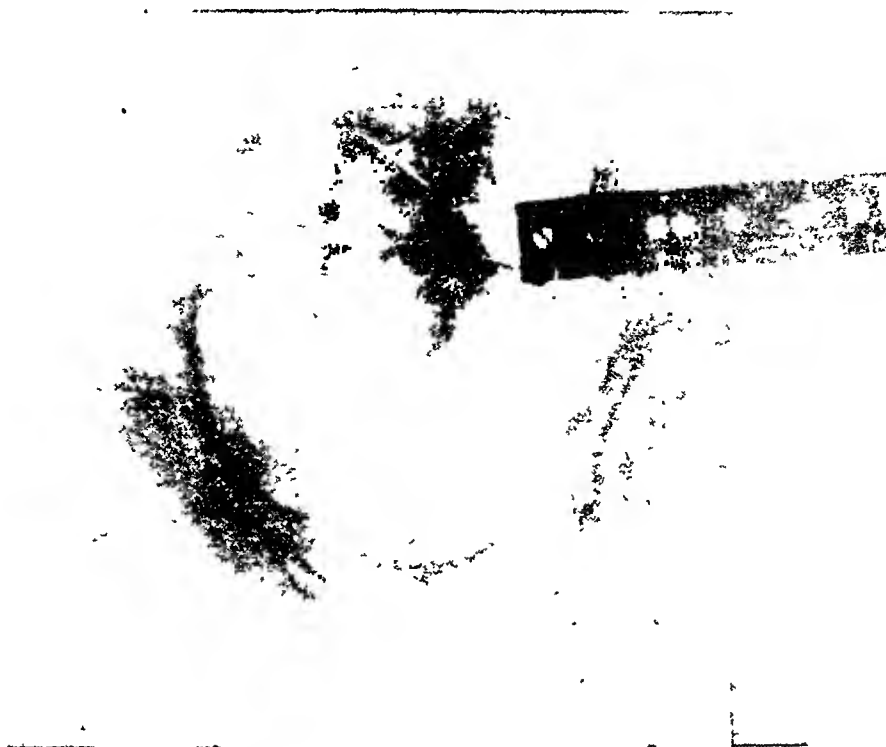


FIG. 10. J. M., intracapsular, midcervical fracture of neck of left femur.

ture than it is in a basilar one. Healing of these fractures is governed by the rules of hyperemic decalcification and ischemic recalcification. When the fragments are imperfectly immobilized, the trauma of motion gives rise to increased and continued hyperemic decalcification with absorption of the neck and non-union. In subcapital fractures with non-union the neck is absorbed because the main source of blood supply comes up from the distal fragment and hyperemic decalcification takes place there. The head in such fractures may be almost entirely avascular; there is no absorption of its calcium content, and it shows up in the x-ray film as a dense hard sequestrum."

There are not many reports in the literature regarding difficulties with the Smith-Petersen nail and the fragmentary information here presented has been gleaned from a study of available literature. A critical examination of the cases reported by Smith-Petersen et al. in 1931¹ shows

that in five out of twenty-four cases reported there was some difficulty with the nail. Thus in Case I, although the nail was driven into the head at the time of operation, subsequent "roentgen examination showed that the nail apparently did not enter the head." In Case III, there was nonunion and absorption of the neck and the nail had to be removed. The x-ray prints suggest extrusion of the nail. In Case IV, the nail had to be removed because there was evidence of bursa formation around its head with pain and tenderness. In Case V, "the nail which was somewhat loose and corroded was removed." In Case VIII, the direction of the nail had to be altered at the time of operation. About seven months later there was a refracture of the neck with extrusion of the nail and a Whitman reconstruction had to be performed.

Watson-Jones⁶ states: "It might be thought probable that absorption of bone round the nail due to an irritative hyperemic decalcification would account for frequent failure . . . That there is some decalcification is undoubted, and the remarkable tightness of the nail when it is

first driven in is not maintained for more than a few weeks. After that time it is not difficult to slide the nail up and down in its socket in the bone."

report of eighteen cases he states: "It is true that after the tool-steel bolts have been in situ for some time, a small area of rarefaction appears about them. However,

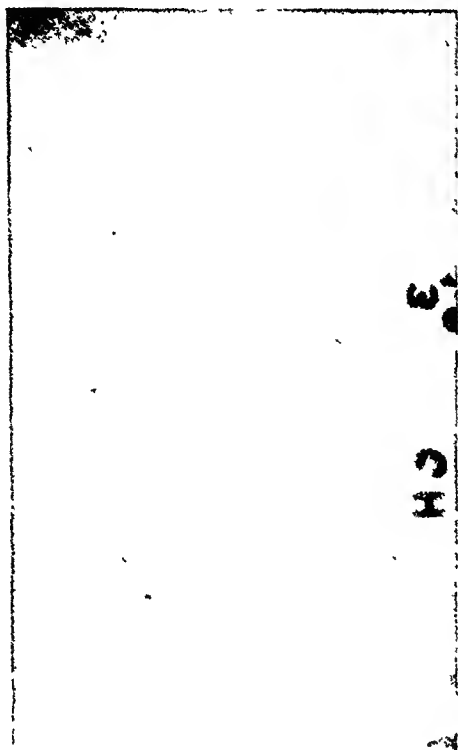


FIG. 11. J. M., after Leadbetter reduction.

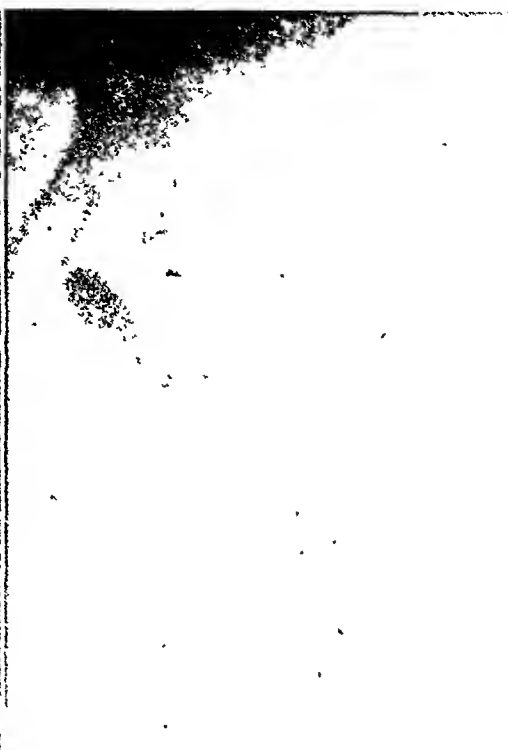


FIG. 12. J. M., anteroposterior view after reduction and insertion of Smith-Petersen nail.

Henderson⁷ advocates the use of a lag screw and states: "The method was developed because in some instances the metal flanged nail became loose."

Hart⁸ advocates fixing the Smith-Petersen nail by a wire threaded through the head of the nail and passed through a drill hole in the shaft of the femur.

Westcott⁹ in reporting twelve cases in which the Smith-Petersen nail was used shows the x-ray prints, one of a case "after insertion of the nail and impaction of the fragments," and the other of the same case "two months later. Note firm bony union, shortening of neck and protrusion of nail head beyond cortex."

Harris¹⁰ reports two cases in a series of fifty in which the nail which was accurately placed at the time of operation later protruded and the head was disengaged. The author ascribes this to early weight bearing.

Lippmann¹¹ uses a corkscrew bolt. In a

as the roentgenograms show, they do not change their position in the hip and healing has always been solid before the rarefaction is observed. There are no symptoms attributable to this rarefaction."

Godoy-Moreira¹² uses an ingenious stud-bolt screw which does not loosen or slip.

Venable and Stuck¹³ state: "It is our observation that nails become loose (in the absence of infection or technical faults) because of electrolytic activity between the constituent metals in the alloy which is sufficiently intense to destroy adjacent bone. The amount of erosion we have found depends upon the constituents of the alloy and their resistance or relative passivity to electrolytic activity in the body fluids. Nickel or chromium-plated steel nails cause marked destruction of bone because of the galvanic cell action of the dissimilar metals. A single unplated nail of so-called

stainless steel is composed of many metals, such as iron, chromium, nickel, etc., and the electro-activity between them, which

on June 30, 1939, and although several requests were addressed to him he failed to report to the follow-up clinic. On March 25, 1940, he

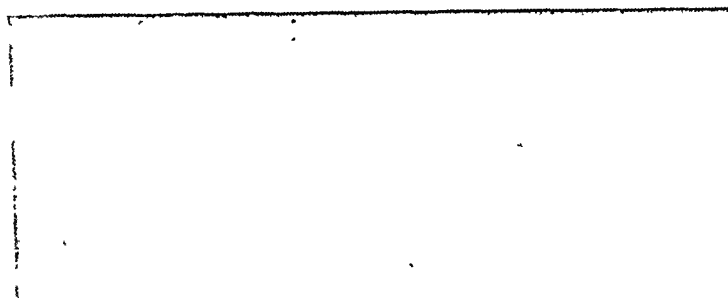


FIG. 13. J. M., lateral view, shows nail not central, but in posterior half of head.

can be demonstrated with a microammeter, will cause bone to be corroded about the nail. Fluid accumulation which seems to indicate infection is more often a body reaction against the local irritation. Cultures of such fluid are invariably negative but chemical examinations usually reveal evidence of metals in solution."

The use of vitallium nails will undoubtedly diminish the incidence of extrusion; but if the composition of the nail is the sole cause of extrusion, it is difficult to explain why extrusion occurs in some nonvitallium nails and does not occur in others.

The following case reports illustrate these difficulties and they are presented in the hope of stimulating further effort to improve methods of fixation now at our disposal. We have recently been using the Austin Moore pins and although the immediate results are satisfactory, it is too early to evaluate the results.

CASE REPORTS

CASE I. S. M., a white male, age fifty-nine, was admitted to Cumberland Hospital on April 21, 1939, with an intracapsular mid-cervical fracture of the neck of the left femur. The fracture line was roughly transverse or at right angles to the long axis of the neck. (Fig. 1) On April 27, 1939, an open operation was performed using an iliofemoral incision, reduction was effected and a Smith-Petersen nail inserted. (Figs. 2 and 3.) He left the hospital

returned to the hospital. He stated that on March 22, 1940, he experienced pain in the left hip and was unable to bear weight with the aid of crutches as he did formerly. X-rays taken on March 23, 1940, showed that the nail had been extruded and that he refractured the neck of his left femur. (Fig. 4.) On April 2, 1940, the nail was removed through a lateral incision, a McMurray osteotomy was performed and a plaster spica applied. (Fig. 5.) It was noted that the nail had practically no grip on the distal fragment and was very easily removed. What probably happened in this case was that nearly eleven months after the operation the nail was extruded from the head and because of inadequate union refracture occurred.

CASE II. F. P., a white female, aged fifty-one, was admitted to Cumberland Hospital on February 25, 1940, with an intracapsular mid-cervical fracture of the neck of the left femur. The line of fracture was oblique and ran from a point close to the head downward and outward so that very little of the neck was attached to the head along the upper border while about half an inch of the neck was attached to the head along the lower border. (Fig. 6.) She showed a four plus Wassermann reaction and gave a history of arrested pulmonary tuberculosis. On February 29, 1940, an open operation was performed using an iliofemoral incision and a Smith-Petersen nail was inserted. (Fig. 7.) After the operation, her lower extremity was placed in Russell traction. On March 9, 1940, her wound showed signs of an infection. Culture from the wound: anaerobic:

negative: aerobic; *Staphylococcus pyogenes*, but this was limited to the soft tissues. X-rays taken on April 3, 1940, (Fig. 8) showed that

some mucous rales in both bases and ran a low grade temperature; her left lower extremity was therefore placed in Russell traction. Her



FIG. 14. J. M., specimen removed at autopsy shows little absorption of neck.



FIG. 15. J. M., another view of specimen removed at autopsy.

the nail was extruded from the head. On April 16, 1940, the nail was removed. It was found loose and it was noted that the infection was limited to the soft tissues. A Leadbetter reduction was performed and a plaster spica was applied. On May 4, she developed bronchopneumonia. Sulfapyridine was administered but she expired on May 9, 1940. At autopsy it was noted that the neck had been completely absorbed. A photograph of the specimen is shown in Figure 9. It was interesting to note that the neck had been completely absorbed in a period of thirty-six days or less. If absorption is due to hyperemic decalcification which in turn is caused by incomplete fixation and motion between the fragments, absorption must have occurred between the time that the nail was extruded and the patient's death. Absorption of the neck is a very important factor in causing nonunion. While a great deal of emphasis has been placed on aseptic necrosis of the head, absorption of the neck has not been sufficiently emphasized. A study of this phase is now being conducted and while it is too early to make any positive statement, the preliminary impression is that neck absorption may, in many cases, be a prelude to aseptic necrosis of the head.

CASE III. J. M., a white female, age seventy-five, sustained an intracapsular fracture of the neck of the left femur on February 27, 1940, (Fig. 10) and was admitted to Cumberland Hospital on the same day. She had

general condition improved and on March 19, 1940, under spinal anesthesia the fracture was reduced by the Leadbetter method and a valgus position of the head was obtained. (Fig. 11.) A lateral incision was made and a Steinman pin was drilled through the great trochanter into the head to anchor the fragments. A narrow, graduated Steinman pin was then drilled just below the site selected for driving the Smith-Petersen nail. This furnishes a valuable guide as to length and direction. A Smith-Petersen nail was then driven through and the fragments were impacted. X-rays showed that the nail passed through the neck and entered the head in its posterior half. (Figs. 12 and 13.) The patient had a smooth convalescence; her wound was clean and the sutures were removed on March 26, 1940. On April 1, 1940, she was permitted up in a chair. On April 6, she developed signs of pyelonephritis and cerebral thrombosis and expired on April 12, 1940. At autopsy it was noted that the fragments were in good alignment with the head in valgus position but there was some play between the head and the neck. After impacting the fragments during operation, it was noted that the head moved with the neck when the thigh was rotated. There was no evidence then of any play between the two fragments and it must be assumed that some loosening occurred during the period of twenty-four days between the operation and the patient's death. There was no absorption of the neck in this case as noted

in Case II. Figures 14 and 15 are photographs of the specimen.

COMMENT

It is not the writer's intention to condemn the Smith-Petersen nail as it has been found very useful in fixing fragments in many cases. However, it would be very desirable if among the data now being assembled on fractures of the neck of the femur, special attention were given to the various methods of internal fixation. It would further be very desirable if a central registry were established to which surgeons all over the country would be invited to report both their successes and their failures. The data thus assembled should provide a basis for a scientific and accurate evaluation and stimulate further research to develop an implement which will give complete fixation without the disadvantages of the implements now at our disposal.

SUMMARY

Three cases of extrusion of the Smith-Petersen nail are presented together with a review of the meager literature on the subject. It is hoped that similar reports from other surgeons may be forthcoming. In this way the mechanical difficulties attendant upon the use of a three-flanged nail can be properly evaluated and eventually eliminated.

A plea is made for a subclassification of intracapsular fractures of the neck of the femur based upon the position of the line of fracture, its inclination and the presence or absence of comminution. While internal fixation is applicable to the majority of

intracapsular fractures, it is believed that there are certain fractures to which it is not applicable, and in which an osteotomy at the outset will save the patient much time and suffering. What this type of fracture is can be determined only by a critical analysis of large series of reports of both successes and failures.

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GALLBLADDER SURGERY*

A TEN YEARS' STATISTICAL REVIEW INCLUDING 410 OPERATED CASES

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THE purpose of this paper is to review ten years' experience in gallbladder surgery on the Fourth Surgical Division of Bellevue Hospital. In 1933, 200 cases were reported. Since then, up to December 1938, 210 additional patients have been operated upon, making a total of 410 operated cases during the ten-year period. The cases were studied in a special gallbladder clinic which was established in 1928. If the history¹ and examination revealed an acute condition present, the patient was at once admitted to the hospital and further work-up done on the ward. Otherwise, the diagnostic work-up was continued in the Out-Patient Department and the patient was not sent into the hospital until his surgical status had been definitely established. A cholecystogram was ordered and the patient given an appointment for biliary drainage.

The cholecystograms are done by the oral dye method. Of the 200 operations reported from this clinic in 1933,² 126 had cholecystograms. The x-ray findings were correct in 72.2 per cent of these cases, as shown at operation. When no visualization of the gallbladder, delayed emptying or shadows of calculi were reported, the findings were confirmed in 80.4 per cent, while if cases showed normal visualization and normal emptying of the gallbladder without shadows of calculi, the x-ray find-

ings were confirmed in but 44.8 per cent of the cases examined.

In our present series of 210 cases, cholecystograms were done in 147 cases with results as shown in Tables I and II. X-ray findings were confirmed at operation in 124 cases (84 per cent correct). In analyzing these findings from the standpoint of two main groups of cases, that is, those in which the gallbladder was seen and those in which the gallbladder was not seen or seen only faintly, delayed emptying or shadows of calculi, we note the following:

The *gallbladder was seen* and appeared normal in the x-ray in ten cases. In five of these cases stones were found at operation. X-ray findings were thus confirmed in 50 per cent of the cases.

The *gallbladder was not seen* or visualized only faintly, or showed shadows of calculi, or delayed emptying in 137 cases. One hundred nineteen cases showed stones at operation. The x-ray findings were thus confirmed in 87 per cent of the cases.

As pointed out in our first series of cases, the great margin of error lies in those cases which visualized normally by x-ray (50 per cent compared with 87 per cent in cases showing a pathological cholecystogram).

The enthusiastic endorsement of biliary drainage by Bochs³ et al. in 1931 served as a great incentive in the performance of this technical procedure. These investiga-

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tors at that time reported their biliary drainage findings in a series of 148 proved cases of cholelithiasis. They stated that in their experience, biliary drainage had proved superior to cholecystography in gallstone diagnosis. They emphasized that the presence of cholesterol crystals and calcium bilirubinate pigment in the same

"In evaluating the diagnostic importance of the crystalline elements in preoperative specimens of bile, one point should always be borne in mind, namely, the number of crystals seen and the amount of pigment observed in the bile. A few scattered crystals, or a small amount of calcium bilirubinate pigment, has not

TABLE I
X-RAY AND OPERATIVE FINDINGS IN 147 CASES OF
PRESENT SERIES, COMPARED WITH SERIES OF
126 CASES REPORTED IN 1933

	Operative Findings					
	1933		1939		1933	
	Stones	No Stones	Stones	No Stones	Stones	No Stones
Number of cases x-rayed	126	147				
Gallbladder did not visualize	90	66	72	57	18	9
Gallbladder did visualize and emptied normally and did not show any shadows of stones	29	10	16	5	13	5
Gallbladder did visualize—and shadows suggestive of calculi were present	5	24	4	23	1	1
Gallbladder did visualize—but showed delayed emptying	2	5	1	4	1	1
Gallbladder visualized faintly		26		19		7
Gallbladder did not visualize shadows of calculi present.		16		16		
Total....	126	147	93	124	33	23

TABLE II
DIAGNOSTIC ACCURACY OF CHOLECYSTOGRAPHY

	Number of Cases		Stones at Operation		X-ray Confirmed, Per Cent	
	1933		1939		1933	
	1933	1939	1933	1939	1933	1939
Gallbladder not visualized, or visualized faintly, or visualized but showed shadows of calculi, or delayed emptying	97	137	78	119	80	87
Gallbladder did visualize and appeared normal in x-rays	29	10	16	5	44.8	50
Total cases	126	147				

much significance diagnostically, but numerous cholesterol crystals and a large amount of calcium bilirubinate pigment, separately or together in bile preoperatively, does indicate in most instances a calculous or non-calculous cholecystitis."

Of Rafsky's sixty-nine cases reported, which showed crystals prior to operation, fifty-nine had stones at operation, twelve had chronic cholecystitis and six showed a normal gallbladder. Carter, Green and Twiss,⁶ stress the value of biliary drainage as a diagnostic measure in cases of biliary stasis. However, they disagree with those who claim that the presence of crystals in the bile is pathognomic of gallstones. Quoting these authors: "The presence of crystals has been described as indicative of the presence of stones. That this is a misleading conclusion is apparent when the operative findings in this series of 239 cases are compared with the duodenal

bile was pathognomic of gallstones. In 1933, Rousselot and Bauman⁴ reported their results of an investigation of one hundred patients by duodenal drainage followed by operation. They stated that the finding of cholesterol crystals or bile pigment granules in diluted or concentrated bile almost certainly indicated the presence of gallstones. Rafsky,⁵ in an analysis of sixty-nine patients operated upon and drained preoperatively by the duodenal tube, is quoted as follows:

drainage findings. In 24.4 per cent of the patients with stones, no crystals were found in the preoperative duodenal drainage, while they were present in 82.6 per cent of the cases without stones. While the presence or absence of crystals has no specific diagnostic import where stones

Our technic of duodenal drainage of the biliary system is essentially the same as originally described by Lyon⁸ in 1919. We believe, however, that certain mechanical improvements in this technic today render the test more successful, more accurate and more understandable.

TABLE III

CORRELATION OF MICROSCOPIC DUODENAL DRAINAGE FINDINGS AT OPERATION IN 209 OPERATED CASES

Microscopic Findings			Calculi Gall-bladder, Cases	Calculi Cystic Duct, Cases	Calculi G.B. and Common Duct, Cases	Calculi G.B. and Cystic Duct, Cases	Calculi G.B., Common Duct and Cystic Duct, Cases	Positive for Calculi		Negative for Calculi, Cases
	Cases	Per Cent						Cases	Per Cent	
Cholesterol.....	50	24	38	2	2	4	0	46	92	4
Calcium bilirubinate....	34	16	20	1	1	5	0	27	79.4	7
Cholesterol and calcium bilirubinate.....	36	17	26	0	1	1	0	28	77	8
Pus.....	3	1	2	0	0	0	1	3	....	0
Blood.....	1	.5	1	0	0	0	0	1	....	0
Negative.....	85	40	43	1	0	3	1	48	58	36

are concerned, they are definitely indicative of stasis in the biliary tract. This is particularly evident in patients presenting dyskinesia of the gallbladder who frequently show an exacerbation of their symptoms at the same time that the duodenal drainage shows the presence of crystals."

In 1933, our² preoperative drainage findings in a series of fifty-six patients operated upon resulted in our stating that the presence of cholesterol crystals or calcium bilirubinate pigment, or both, in biliary drainage bile was usually associated with cholelithiasis. However, in 1938, after five years of further experience with this method of diagnosis, our attitude toward the diagnostic significance of crystals changed. At that time Doran, Forster and Spier⁷ analyzed sixty-four, cases in which operation was performed and the patients drained preoperatively, and concluded that the finding of crystals in the bile was not pathognomic of stones but was evidence of pathology in the biliary tract.

The first of these mechanical aids is the Twiss tube;⁹ second, is the horizontal tilt table fluoroscope. For the past year and a half we have been using this type of table in our clinic. Prior to this time we had done 1,062 drainages in this Clinic with 198 or 18.6 per cent unsuccessful. Since the installation of this equipment, we have done 248 drainages of which only fourteen have been unsuccessful, a percentage of 5.6, thus reducing our total for 1,310 drainages to 16.1 per cent.

TABLE IV
SEX

	First Series 200 Cases	Second Series 210 Cases
Females.....	161, or 80.5%	163, or 77.6%
Males.....	39, or 19.5%	47, or 22.4%

The technic of nonsurgical biliary drainage on the tilt table fluoroscope is comparatively simple. The tube is ingested with the patient in the erect position, and then with

careful, short exposures, the tube is visualized entering the cardiac orifice of the stomach and progressing along the greater curvature toward the pylorus. The table is then tilted backward toward the horizontal position. This maneuver causes the greater curvature to rise from approximately the level of the crests of the ilium to the level of the last dorsal vertebra, and the bucket of the tube is then either at the pyloric orifice or just past it. Any excess of tube is then retracted. With the hand that is shielded by a lead glove, the stomach is elevated by pressure on the greater curvature and the tube is directed through the pylorus and into the duodenum.

TABLE V
AGE

	First Series 200 Cases	Second Series 210 Cases
Average	41	46 2
Youngest	20	20
Oldest	70	78

In the passage through the stomach, the gastric contents are aspirated, first, to hasten the passage to the duodenum, and second, to determine the presence or absence of free hydrochloric acid. This is hastily, though roughly, accomplished by means of the indicator, nitrazene. A notation is then made on the chart for the benefit of clinical therapy and diagnosis. In those cases that present difficulty in manipulating the tube through the pylorus, the stomach is filled with warm saline or sometimes with plain water. In certain cases, especially when the patient is excitable and gags frequently, the tube will not pass through the pyloric orifice because the hand on the abdominal wall is not sufficient to control the spasm of the stomach when stimulated by gag reflex. Distended with warm water the stomach is more easily manipulated. When the tube has passed through the pylorus and the first portion of the duodenum, the patient is rotated over to the right side. When in this position,

the second portion of the duodenum is the most dependent portion and becomes the limbus of a U-tube that holds between 30 and 50 cc.

With the bucket of the tube in the second portion of the duodenum, the duodenal contents are aspirated, and one ounce of a 25 per cent solution of magnesium sulphate is instilled. The tube is clamped off for five minutes, then reopened to drain as a syphon. The following notes are made: First, the presence or absence of bile; second, is the initial flow of golden yellow bile followed by a flow of concentrated bile without any further stimulation?

In the original communication of Meltzer he contended that relaxation of the sphincter of Oddi² would lead to the evacuation of the gallbladder, according to the law of contrary innervation of sphincters. At that time, it was believed that when the sphincter relaxed, the gallbladder contracted. Recent physiological investigation fails to substantiate this hypothesis. It is, however, an established physiological fact that when the gallbladder contracts, the sphincter relaxes.

We believe that magnesium sulphate acts on the sphincter of Oddi as a local anesthetic agent, and that the relaxation of the sphincter by magnesium sulphate results in a flow of common duct bile. It has no direct effect upon the gallbladder itself. In some instances there is a flow of concentrated bile following the relaxation of the sphincter. This is neither expected nor normal, although it happens not infrequently in any group of patients with gallbladder disease.

After releasing the clamp following the injection of the magnesium sulphate, 30 cc. of golden yellow (light) bile are collected. In those cases in which concentrated (dark) bile proceeds to flow spontaneously, we wait until the flow of dark bile ceases and the light bile is again running freely. Then we instill one ounce of olive oil through the tube and again clamp it off for from five to ten minutes. When the tube is released we collect the bile specimen and note the

presence or absence of concentrated bile. In those cases in which a rather large amount of concentrated bile flows following the introduction of magnesium sulphate, the stimulation obtained by the olive oil may result in a further flow of concentrated bile. This should be carefully noted.

Examination is then made microscopically without the use of stain or fixation. This examination is for the presence or absence of cholesterol crystals and calcium bilirubinate. Cholesterol crystals appear as four sided figures with one corner punched off. They may be the extreme of a rectangle or almost as equally sided as squares, but there is always one corner broken off squarely. They are colorless and, even in the most concentrated bile, remain so. Calcium bilirubinate can be seen in the same way, at the same time and its presence is indicative of biliary pathology. It usually appears in an amorphous form, translucent and orange colored, but may appear as red granules.

We have performed 1,310 nonsurgical biliary drainages on 491 patients (1.3.). One patient has been drained twenty times over a period of five years, and a second patient has been drained ten times over a three-year period. Except for these two patients, the procedure has been limited to one or two diagnostic drainages in patients upon whom surgery has been performed. Postoperative drainages have been used routinely to determine the function of the sphincter of Oddi and the presence or absence of bile or crystals.

Of the 491 patients drained, 209 were operated upon. It must be remembered that all of these patients were referred to this Clinic by either general medical or general surgical clinics with the provisional diagnosis of gallbladder disease. Of the 491 patients on whom drainages were performed, operation was recommended in 236, or 48 per cent. Of these, twenty-seven refused operation or preferred to have their surgery performed elsewhere by private surgeons, leaving a total number of 209 cases, or 42.6 per cent operated

upon. Of these 209 in which biliary drainage was performed, three cases were found to be negative at operation for biliary pathology, or 1.4 per cent. Of the remaining 255 patients, 214 were treated medically for disease of the biliary system and forty-one were referred to other clinics for treatment.

Of the 209 patients who were drained preoperatively, 113, (54 per cent) showed concentrated bile in varying amounts. Of these cases, calculi were found in seventy-eight (69 per cent). Ninety-six (46 per cent) did not show concentrated bile at the preoperative drainage, and of these cases sixty-nine (72 per cent) were found to possess calculi. It is, therefore, our belief that the presence or absence of concentrated bile in the preoperative drainage, bears no direct relationship to the presence or absence of calculi found at the time of operation. It is also our belief that in regard to the gallbladder, the presence of concentrated bile denotes only patency of the cystic duct and gallbladder function in terms of the ability of the viscus to concentrate bile.

In 120 of the 209 cases, either cholesterol crystals or bilirubin calcium pigment or both of these were present. Table III shows a correlation between microscopic findings in biliary drainage and findings at operation in 209 cases. Fifty cases showed cholesterol crystals in the bile prior to operation. Stones were found in forty-six cases (92 per cent). Thirty-four cases showed bilirubin calcium in the preoperative bile. Stones were present at operation in twenty-seven cases (79.5 per cent). Both cholesterol crystals and bilirubin calcium pigment were found in thirty-six cases. Stones were present at operation in twenty-eight of these cases (77.8 per cent). In eight-five cases no crystals were seen in the bile obtained by duodenal drainage. Calculi were found in forty-nine cases (57.6 per cent).

These findings indicate that when cholesterol crystals or bilirubin calcium pigment are found in bile obtained by duodenal

drainage prior to operation, there is a strong probability that stones are present. However, the absence of cholesterol crystals or bilirubin calcium pigment is not a reliable indicator of the absence of stones.

We appreciate well that nonsurgical biliary drainage has both its proponents and opponents, but we regard it as a necessary and important link in the diagnostic chain. We do not believe that it supplants the x-ray or the cholecystogram; we do not hold that it is the pathognomic test of biliary tract disease; but we definitely believe that in our hands it has been a valuable adjunct in the diagnosis of biliary pathology. In our studies relative to determining those cases that should be treated medically, we are of the opinion that it is most important. We have operated upon only 42 per cent of our gallbladder patients with a resultant decrease in both our mortality and morbidity statistics.

Nonsurgical biliary drainage has been utilized in our Clinic postoperatively as a means of determining the function of the sphincter of Oddi and as an aid in its management. It is our belief that much of the postoperative morbidity following operation on the gallbladder is due to spasm of the muscle of the sphincter of Oddi. It has been our experience that in the absence of any concomitant disease such as ulcerative colitis, chronic appendicitis and the various hypertonic states, that biliary drainage is a valuable adjunct. We believe that it is but one part of postoperative management and that without dietary regulation, general hygienic measures and the judicious use of sedatives and antispasmodics, it cannot stand alone. We do hold, however, that the common and hepatic ducts not infrequently are the sites of origin of very definite pathology including the formation of calculi. We further believe that operative interference destroys temporarily the continuity of the hepatobiliary system, and that postoperative management of all gallbladder patients is as essential in the eventual morbidity of any given series as

is the preoperative treatment and the operative technique.

If the history, physical findings, cholecystogram and drainage findings indicate the presence of gallbladder disease, the patient is admitted to the hospital ward. Here the following further work-up is given while preparation for the operation proceeds: icteric index, blood cholesterol, blood sugar, nonprotein nitrogen, bleeding time, clotting time, Van den Bergh test, bile in urine, blood Wassermann, urinalysis, complete blood count. At operation cultures are made of the gallbladder wall and gallbladder bile whenever possible.⁶ Following discharge from the ward, the patient is referred to the gallbladder clinic where the patient is seen at weekly intervals until well, and then at longer periods. Periodic gallbladder drainages are done to ascertain the character of the bile. Diets and medications are prescribed, including sedatives and antispasmodics as indicated.

Our routine operative and postoperative treatment is outlined elsewhere.² During the past two years we have discontinued our past practice of using spinal anesthesia routinely. We insert T-tubes whenever the common duct has been opened and when indicated take a cholangiogram to determine the presence of any calculi which have been overlooked in the common duct. In jaundice cases with prolonged clotting time, we give vitamin K and bile salts supplemented by blood transfusions if necessary. We routinely use catgut for sutures and ligatures. Recently we have used both silk and cotton thread in place of catgut.

The following statistical study is based on 410 patients with benign biliary tract disease, operated upon on the wards of the Fourth Surgical Division of Bellevue Hospital during the past ten years. It includes the present series of 210 cases and 200 cases reported previously. It does not include those cases in which operation revealed a normal gallbladder, malignancy or pathology of adjacent organs.

Of the present series of 210 cases, 163 or 77.6 per cent were females, and forty-

seven or 22.5 per cent were males (Table iv). The ages ranged from twenty to seventy-eight years, the average being 46.2 years (Table v).

There were 127 (60.5 per cent) cases of chronic cholecystitis with stones, twenty-six (12.4 per cent) cases of chronic cholecystitis without stones, thirty-three (15.7 per cent) cases of acute cholecystitis with stones, ten (4.8 per cent) cases of acute cholecystitis without stones, and fourteen (6.7 per cent) cases of stones in the common duct. Each of these groups will be analyzed separately.

CHRONIC CHOLECYSTITIS WITH STONES— 127 CASES

History. The average age was forty-three years, the youngest was twenty-one, the oldest seventy-two years. There were twenty males (15.7 per cent) and one hundred and seven females (84.3 per cent). The chief complaint was pain in 125 cases. The duration of attacks of pain varied from two hours to eighteen years. Seven (5.6 per cent) patients had had previous cholecystostomy; three (3.4 per cent) had had typhoid fever. In ninety-two (73.8 per cent) cases the pain was localized in the right upper quadrant and in forty-three (34.4 per cent) cases in the epigastrium. The pain was colicky in one hundred (80 per cent) patients, dull aching in fourteen (11.2 per cent); radiated to the back in ninety-five (76 per cent) and to the right shoulder in sixty-one (48.8 per cent); it was aggravated by food in thirty-three (26.4 per cent) and by fats in twenty-nine (23.2 per cent). The pain required a hyperdermic of morphine sulphate in twenty-three (18.4 per cent) cases. The associated symptoms were as follows: Nausea, ninety-seven (76.4 per cent) cases; vomiting, eighty-eight (69.3 per cent); belching, ninety-seven (76.4 per cent); distention, 101 (79.5 per cent), persistent jaundice, nine (7.1 per cent); transient jaundice, twenty (15.7 per cent); clay colored stools, seventeen (13.4 per cent); fever, twenty-nine (22.8 per cent); chills,

twenty-nine (22.8 per cent). Loss of weight occurred in fifty-seven (44.9 per cent) cases; average loss nineteen pounds; loss of thirty pounds or more in fifteen (11.8 per cent) cases; lowest loss four pounds, greatest loss fifty pounds.

Physical Examination. The temperature was normal in eighty-three (66.9 per cent) cases and elevated in forty-one (33.1 per cent). The pulse was under ninety in eighty-five (70.8 per cent) cases and over ninety in thirty-five (29.2 per cent); seventy-five (82.5 per cent) patients were obese, thirty-nine (32.5 per cent) were average; three (2.5 per cent) were emaciated; jaundice was present in fourteen out of 108 (13.0 per cent) cases. Tenderness was present in the right upper quadrant in ninety-six (75.6 per cent) cases, rigidity in twenty-nine (22.8 per cent) and mass in nineteen (15.0 per cent).

Laboratory Tests. The average white cell count in ninety-three cases was 11,400, polys 73 per cent, blood cholesterol was done in sixty-six cases; the average was 163, lowest ninety-three, and highest 307. Icteric index was taken in seventy-five cases; average was 9.8, lowest two, and highest seventy. Direct Van den Bergh was positive in fourteen out of sixty-six (24.2 per cent) cases. The average blood sugar in seventy-eight cases was 105. The average blood urea in eighty-four cases was 15.5. The average bleeding time in fifty-four cases was 2.5 minutes, coagulation time 4.1 minutes.

Operative Procedure. Cholecystectomy was performed in 127 cases. Findings: Gallstones in gallbladder in all cases. Pathological reports: chronic cholecystitis 115 (90.6 per cent) cases, cholesterosis of gallbladder, eight (6.3 per cent), no report in four cases. Deaths: three cases (2.4 per cent). Cause of death: (1) Pulmonary embolus, sixteen days postoperatively (autopsy); (2) death on first postoperative day, cause unknown (no autopsy); (3) bile peritonitis due to injury to right hepatic duct; died twenty-five days postoperatively (autopsy).

CHRONIC CHOLECYSTITIS WITHOUT STONES— TWENTY-SIX CASES

History. The average age was forty-one years. The youngest was twenty-seven, the oldest sixty-four years. There were five (19.2 per cent) males and twenty-one (80.8 per cent) females. The chief complaint was pain in every case. The duration of attacks of pain varied from four days to twenty-five years. One (3.8 per cent) patient had had a previous cholecystostomy; none had had typhoid fever. The pain was localized in the right upper quadrant in eighteen (69.2 per cent) cases and in the epigastrium in sixteen (61.5 per cent) cases. It was colicky in character in eight (30.8 per cent) cases and dull aching in eight (30.8 per cent) cases; it radiated to the back in seventeen (65.4 per cent) cases and to the right shoulder in eleven (42.1 per cent) cases; it was aggravated by food in eight (30.8 per cent) cases and by fats in five (19.2 per cent) cases. In only one (3.8 per cent) case was a hyperdermic of morphine sulphate required for relief. Associated symptoms were as follows: nausea in twenty-one (80.8 per cent) cases, vomiting in twenty-two (84.6 per cent) cases, belching in twenty (76.9 per cent) cases, distention in eighteen (69.2 per cent) cases, transient jaundice in five (19.2 per cent) cases, clay colored stools in two (7.8 per cent) cases, fever in seven (26.9 per cent) cases, chills in six (23.1 per cent) cases, loss of weight occurred in ten (38.5 per cent) cases; the average loss was twenty-six pounds, the lowest loss was four pounds, the greatest loss forty pounds.

Physical Examination. The temperature was normal in nineteen (86.4 per cent) cases and elevated in three (13.7 per cent) cases. The pulse was under 90 in fourteen (63.7 per cent) cases and over 90 in eight (36.3 per cent) cases.

Thirteen (59.1 per cent) patients were obese, eight (36.7 per cent) cases average and one (4.5 per cent) emaciated. Jaundice was present in two out of twenty-two (9.0 per cent) cases. There was tenderness in

the right upper quadrant in twenty (76.9 per cent) cases, and rigidity in four (15.4 per cent) cases.

Laboratory Tests. Average white cell count was 9,100, and polys 70 per cent. The average blood cholesterol in sixteen cases was 154, the lowest was ninety, and the highest 211. The icteric index in seventeen cases was 7.9 per cent, the lowest was two, and the highest forty. The direct Van den Bergh test was positive in three out of eighteen (16.5 per cent) cases. The indirect Van den Bergh test was positive in four out of eighteen (22.2 per cent) cases. The blood sugar average in eighteen cases was 101. The average blood urea in nineteen cases was sixteen. The average bleeding time in ten cases was 2.4 minutes and the coagulation time four minutes.

Operative Procedure. Cholecystectomy was performed in every case; choledochostomy in one. Findings: Chronic cholecystitis without stones in all cases. Pathological reports: Chronic cholecystitis in twenty-two (84.6 per cent) cases, cholesterosis of gallbladder in three (11.5 per cent) cases. No report in one case. Deaths: One case (3.8 per cent). Cause of death: liver death, patient died twenty-four hours postoperatively, temperature 107° (no autopsy).

ACUTE CHOLECYSTITIS WITH STONES— THIRTY-THREE CASES

History. The average age was fifty years, the youngest was twenty-five, the oldest seventy-eight years. There were fourteen males (42.4 per cent) and nineteen (57.6 per cent) females. The chief complaint was pain in thirty-one cases. The duration varied from four hours to three years. In one (3.2 per cent) case cholecystostomy had already been performed. There was no history of typhoid fever. The pain was localized in the right upper quadrant in twenty-six (83.9 per cent) cases and in the epigastrium in nine (29.0 per cent) cases. It was colicky in character in fifteen (48.4 per cent) cases and dull aching in ten (32.2 per cent) cases. It radiated to the back in sixteen

(51.6 per cent) cases, and to the right shoulder in thirteen (41.9 per cent) cases; it was aggravated by food in five (16.1 per cent) cases and by fats in one (3.3 per cent) case. The pain required a hyperdermic of morphine sulphate in three (9.7 per cent) cases. The associated symptoms were as follows: nausea in twenty-six (78.8 per cent) cases, vomiting in twenty-four (72.7 per cent) cases, belching in twenty (60.6 per cent) cases, distention in twenty (60.6 per cent) cases, persistent jaundice in one (3.0 per cent) case, fever in fifteen (45.5 per cent) cases, chills in fifteen (45.5 per cent) cases. Loss of weight occurred in nine (27.4 per cent) cases; the average loss was twenty-four pounds. In two (6.0 per cent) cases the loss was thirty pounds or more. The greatest weight loss was sixty pounds.

Physical Examination. The temperature was normal in four (12.1 per cent) cases and elevated in twenty-nine (87.9 per cent) cases. The pulse was under 90 in eleven (34.4 per cent) cases and over 90 in twenty-one (65.6 per cent) cases. Twelve (40 per cent) patients were obese and seventeen (56.7 per cent) were average. Jaundice was present in five out of ten (50 per cent) cases. Tenderness in the right upper quadrant was present in thirty (9.9 per cent) cases, rigidity in nineteen (57.6 per cent) cases and mass in ten (30.3 per cent) cases.

Laboratory Reports. The average white cell count was 15,700, polys 84 per cent. The blood cholesterol in seventeen cases averaged 158, lowest 125, highest 267. Icteric index in twenty cases averaged 11.6, lowest two, highest thirty. The direct Van den Bergh test was positive in four out of twenty-two (18.2 per cent) cases. The indirect Van den Bergh test was positive in six out of twenty-two (27.3 per cent) cases. The average blood sugar was 109 in nineteen cases. The average blood urea was 16.5 in twenty-three cases, lowest twelve, highest twenty-two. Bleeding time was 3.2 minutes.

Operative Procedure. Cholecystectomy

was performed in twenty-six (78.8 per cent) cases; cholecystostomy in seven (21.2 per cent). Findings: acute cholecystitis with stones in gallbladder in all cases. Pathological reports: Acute cholecystitis in twenty-six (78.8 per cent) cases; no reports in seven cases. Deaths: Three cases (9.1 per cent). Cause of death: (1) Fourth postoperative day; cause uncertain (no autopsy); (2) peritonitis sixth postoperative day (no autopsy); (3) cardiac failure first post-operative day (no autopsy).

ACUTE CHOLECYSTITIS WITHOUT STONES— TEN CASES

History. The average was forty-six years, the youngest was twenty, the oldest seventy-two years. There were five (50 per cent) males and five (50 per cent) females. The chief complaint was pain in nine cases. The duration of attacks of pain varied from two days to ten years. Cholecystostomy had been performed in one case. In one (10 per cent) case there was a history of typhoid fever. The pain was localized in the right upper quadrant in five (55.6 per cent) cases, and in the epigastrium in six (66.7 per cent) cases. The pain was colicky in character in six (66.7 per cent) cases and dull aching in two (22.2 per cent) cases; it radiated to the back in five (55.0 per cent) cases and to the right shoulder in three (33.3 per cent) cases; it was aggravated by food in four (44.4 per cent) cases and by fats in two (22.2 per cent) cases. In no case was a hyperdermic of morphine sulphate used for relief. The associated symptoms were as follows: nausea in eight (80 per cent) cases, vomiting in eight (80 per cent) cases, belching in seven (70 per cent) cases, distention in six (60 per cent) cases, persistent jaundice in two (20 per cent) cases, transient jaundice in no cases, clay colored stools in no cases, fever in six (60 per cent) cases, chills in five (50 per cent) cases. There was loss of weight in four (40 per cent) cases; the average loss was twelve pounds, and the greatest loss was twenty-five pounds.

Physical Examination. The temperature was normal in two (20 per cent) cases and elevated in eight (80 per cent) cases. The pulse was under 90 in five (50 per cent) cases and over 90 in five (50 per cent) cases; six (60 per cent) patients were obese, three (30 per cent) were average. Jaundice was present in two out of five (40 per cent) cases. There was tenderness in the right upper quadrant in eight (80 per cent) cases, rigidity in seven (70 per cent) cases and a mass in two (20 per cent) cases.

Laboratory Reports. The average white cell count was 12,500, polys 80 per cent. The average blood cholesterol in three cases was 150, the lowest was 130 and the highest was 160. The average icteric index in four cases was 26.5, the lowest was three and the highest was ninety. The direct Van den Bergh test was positive in two out of five (40 per cent) cases. The indirect Van den Bergh test was positive in two out of five (40 per cent) cases. The blood sugar averaged 133 in five cases. The blood urea in six cases averaged sixteen, the lowest thirteen and the highest eighteen. The bleeding time in five cases averaged 2.2 minutes and the coagulation time 4.2 minutes.

Operative Procedure. Cholecystectomy was performed in four (40 per cent) cases, cholecystostomy in six (60 per cent) cases. Findings: Acute cholecystitis without stones in all cases. Pathological reports: Acute cholecystitis in five (50 per cent) cases. No report in five cases, gallbladder not having been removed at the time of operation. Deaths: None. In two of these cases gallstones were found in the gallbladder at a subsequent operation. In another case in which the gallbladder had perforated directly into the peritoneal cavity, the stone or stones may have escaped through the perforation.

STONES IN COMMON DUCT—FOURTEEN CASES

History. The average age was fifty-one years, the youngest was thirty years and the oldest was sixty-seven years. There were three (21.4 per cent) males and

eleven (78.6 per cent) females. The chief complaint was pain in fourteen cases. The duration of symptoms varied from one day to twenty years. There was no history of typhoid fever. The past history revealed cholecystostomy in one (7.1 per cent) case and choledochostomy in one (7.1 per cent) case. The pain was localized in the right upper quadrant in seven (50 per cent) cases and in the epigastrium in seven (50 per cent) cases. The pain was colicky in character in ten (71.4 per cent) cases and dull aching in three (21.4 per cent) cases, radiated to the back in nine (64.3 per cent) cases and to the right shoulder in three (21.4 per cent) cases; it was aggravated by food in two (14.3 per cent) cases and by fats in two (14.3 per cent) cases. The pain was relieved by a hyperdermic of morphine sulphate in two (14.3 per cent) cases. The associated symptoms were as follows: nausea in eleven (78.6 per cent) cases, vomiting in ten (71.4 per cent) cases, belching in ten (71.4 per cent) cases, distention in ten (71.4 per cent) cases. There was persistent jaundice in four (28.6 per cent) cases, transient jaundice in six (42.9 per cent) cases, clay colored stools in seven (50 per cent) cases, fever in eight (57.1 per cent) cases, chills in eight (57.1 per cent) cases. There was a loss of weight in ten (71.4 per cent) cases. The average loss was twenty-four pounds. A loss of thirty pounds or more occurred in two (13.3 per cent) cases, the greatest loss being fifty pounds.

Physical Examination. The temperature was normal in four (28.6 per cent) cases, and elevated in ten (71.4 per cent). The pulse was under 90 in six (42.9 per cent) cases and over ninety in eight (57.1 per cent) cases. Six (50 per cent) patients were obese and four (33.3 per cent) cases average. Jaundice was present in eight out of nine (88.9 per cent) cases. There was tenderness in the right upper quadrant in seven (50 per cent) cases, rigidity in five (21.4 per cent) cases and a mass in one (7.1 per cent) case.

Laboratory Reports. The average white cell count in thirteen cases was 10,500

polys, 81 per cent. The average blood cholesterol in ten cases was 175, lowest 140 and the highest 267. The average icteric index in twelve cases was thirty-nine, lowest five and highest ninety. The direct Van den Bergh test was positive in nine out of eleven (81.8 per cent) cases. The blood sugar in twelve cases averaged 109. The blood urea in thirteen cases averaged 16.8, lowest twelve and the highest twenty-eight. The bleeding time in eight cases averaged 2.1 minutes and the coagulation time was 5.3 minutes. Blood Wassermanns were taken in thirteen cases and found to be negative.

TABLE VI
OPERATIVE PROCEDURES IN 410 CASES OF BILIARY TRACT DISEASE

	Cholecystectomy	Cholecystostomy	Choledochostomy
Chronic cholecystitis with stones	127		
Chronic cholecystitis without stones	26		1
Acute cholecystitis with stones	26	7	
Acute cholecystitis without stones	4	6	
Stones in common duct	8	2	14
Total (1939 series)	191	15	15
Total (1933 series)	190	10	7
Combined total	381	25	22

Operative Procedure. Cholecystectomy in eight (57.1 per cent) cases, cholecystostomy in two (14.2 per cent) cases and choledochostomy in fourteen (100 per cent) cases. Findings: Stones in common duct in every case. Chronic cholecystitis with stones in seven (50 per cent) cases and acute cholecystitis with stones in one (7.1 per cent). Pathological reports: Chronic cholecystitis with stones in seven (50 per cent) cases; acute exudative cholecystitis with stones in one (7.1 per cent) case. Deaths: Five deaths (35.7 per cent). Cause of death: (1) Peritonitis, sixth postoperative day (no autopsy); (2) pulmonary embolus, fourth week postoperatively (no

autopsy); (3) liver death, twenty-four hour postoperatively (no autopsy); (4) cardiac failure, second postoperative day (no autopsy); (5) collapse of lung, bilateral pleurisy, septic splenitis, biliary nephrosis, fourth postoperative day (autopsy).

TABLE VII
OPERATIVE FINDINGS IN 410 CASES OF BILIARY DISEASE
Operative Findings Compared with Series Previously Reported Are Presented in Table VII

	1933 Cases	1939 Cases
Chronic cholecystitis with stones	124	127
Chronic cholecystitis without stones	51	26
Acute cholecystitis with stones	21	33
Acute cholecystitis without stones	4	10
Stone in common duct	*	14
Total	200	210

* In the 1933 series of 200 cases the common duct was opened seven times to remove calculi.

The operative procedures are recorded in Table VI and operative findings in Table VII.

TABLE VIII
BACTERIOLOGIC CULTURES FROM GALLBLADDER WALL
IN 60 BILIARY TRACT CASES

	Total Cases	Positive Cultures	No Growth
Acute cholecystitis without stones	2	0	2
Acute cholecystitis with stones	8	7	1
Total	10	7	3
Chronic cholecystitis without stones	8	3	5
Chronic cholecystitis with stones	42	23	19
Total	50	26	24
Grand total	60	33	27

Table VIII shows the bacteriological findings in sixty cases in which cultures were taken from gallbladder wall at the time of operation. Positive cultures occurred in thirty-three out of sixty (55 per cent) cases. The organisms most

frequently found in the gallbladder wall in sixty operated cases were *Bacillus coli* (42 per cent) *Staphylococcus aureus*, (24 per cent), gram-negative bacillus and

TABLE VIII
BACTERIOLOGIC CULTURES FROM THE GALLBLADDER WALL
IN 60 BILIARY TRACT CASES

Variety of Bacteria Cultured	Acute Cholecystitis	Chronic Cholecystitis	Totals, Per Cent
<i>B. Coli</i>	4	10	14 (42)
<i>Str. viridans</i>	1	1	2 (6)
<i>Staph. aureus</i>	2	6	8 (24)
<i>Staph. aureus</i> and gram negative bacillus		4	4 (12)
<i>Staph. aureus</i> and <i>str. viridans</i>		2	2 (6)
Gram-positive bacillus		1	1
Diphtheroids		2	2
<i>B. typhosus</i>		0	0

Staphylococcus aureus (12 per cent), *Streptococcus viridans* (6 per cent), *Staphylococcus aureus* and *Streptococcus viridans* (6 per cent).

Table IX shows bacteriological findings in ninety-six cases in which cultures were

TABLE IX
BACTERIOLOGIC CULTURES FROM FLUID CONTENTS
OF GALLBLADDER IN 96 BILIARY TRACT CASES

	Total Cases	Positive Cultures	No Growth
Acute cholecystitis without stones	6	4	2
Acute cholecystitis with stones	11	9	2
Total	17	13	4
Chronic cholecystitis without stones	12	5	7
Chronic cholecystitis with stones	67	31	36
Total	79	36	43
Grand total	96	49	47

made from the fluid contents of gallbladders removed at operation. Positive cultures occurred in forty-nine out of ninety-six cases (51 per cent). *Staphylococcus aureus* occurred in 27 per cent of the

positive cultures, *Bacillus coli* in 22 per cent, and *Streptococcus viridans* in 14 per cent.

TABLE X
BACTERIOLOGIC CULTURES FROM FLUID CONTENTS OF
GALLBLADDER IN 96 BILIARY TRACT CASES

Variety of Bacteria Cultured	Acute Cholecystitis	Chronic Cholecystitis	Totals
<i>B. coli</i>	3	8	11 (22%)
<i>Str. viridans</i>	3	4	7 (14%)
<i>Str. viridans</i> and <i>B. coli</i>	1		1
<i>Str. viridans</i> and gram positive bacillus		1	1
<i>B. Welchii</i>	1		1
<i>Staph. aureus</i>	3	10	13 (27%)
<i>Staph. aureus</i> and <i>str. viridans</i>		2	2
<i>Staph. aureus</i> and <i>str. non-hemolyticus</i>		1	1
<i>Staph. aureus</i> and <i>B. Coli</i>	1		1
<i>Staph. aureus</i> and gram positive bacillus		1	1
<i>Staph. aureus</i> and gram negative bacillus		2	2
<i>Staph. aureus</i> and diphtheroids	1		1
<i>B. subtilis</i>		1	1
Diphtheroids		2	2
Gram-positive bacillus		2	2
Indifferent str		1	1
<i>B. Morgagni</i>		1	1
<i>B. typhosus</i>	0	0	0

Complications (Table x) occurred in ninety-three cases out of the series of 410 operated cases. The most frequent complication was wound infection which occurred in thirty-four (8 per cent) cases, Pneumonia occurred in eleven cases, cardiac decompensation in eight cases and postoperative shock in five.

Of the 410 patients operated upon, twenty-six died, a mortality rate of 6.3 per cent. If cases of acute cholecystitis and common duct stone are excluded, the mortality rate in the recent series of 210 cases becomes 2.6 per cent. The causes of death are listed in Table x1.

FOLLOW-UP RESULTS

Of the 410 cases operated upon in which gallbladder pathology was found, there

were twenty-six deaths, leaving 384 cases to be followed. We have followed 222 (58 per cent) cases for periods ranging from six months to five years, except twenty-one cases which were followed for only three months. In the follow-up study we inquired as regards right upper quadrant pain, dull aching in character, or colicky; radiating to the back or right shoulder. We grouped under indigestion the symptoms of nausea, vomiting, belching and distention. Any recurrence of jaundice was also recorded.

TABLE X
POSTOPERATIVE COMPLICATIONS IN 410 CASES OF
BILIARY TRACT DISEASE

	1933 Cases	1930 Cases
Hemorrhage	1	
Pneumonia	5	6
Dehiscence of wound	3	2
Phlebitis	1	1
Massive collapse of lung	1	
Bile sinus, 21 days	1	
Pulmonary embolus	3	2
Wound infection	11	23
Cardiac decompensation	2	6
Dry pleurisy	1	
Pansinusitis	1	
Chronic bronchitis	1	
Heat prostration		1
Cerebral arterial thrombosis		2
Bile peritonitis		1
Atelectasis		2
Diabetes		1
Peritonitis		2
Parotitis		1
Postoperative shock		5
Hematoma of wound		1
Fecal fistula		1
Prostatic obstruction		1
Bronchiectasis		1
Duodenal fistula		1
Liver abscess		1

I. Chronic Cholecystitis with Stones—149 Cases. One hundred and five (70 per cent) patients were symptom free and forty-four had persistent symptoms after operation as follows: seventeen patients had attacks of pain following operation, thirty-two indigestion and one jaundice.

II. Chronic Cholecystitis without Stones—39 Cases. Sixteen (41 per cent) pa-

tients were symptom free and twenty-three had persistent symptoms after operation as follows: nine had attacks of pain and nineteen indigestion.

III. Acute Cholecystitis with Stones—22 Cases. Eighteen (81 per cent) patients were symptom free and four had persistent symptoms after operation as follows: three had attacks of pain and indigestion; one had indigestion only.

TABLE XI
410 OPERATED CASES OF BILIARY TRACT DISEASE: CAUSES
OF DEATH

	1933	1930
Number of cases	200	210
Number of deaths	14	12*
Per cent deaths	7%	5.7% (3.6%)* (2.6%)*†
Causes of death:		
Postoperative pneumonia	5	
Shock (death within 48 hours from so-called liver deficiency)	3	2
Pulmonary embolus	3	2
Cardiac decompensation	1	2
Postoperative	1	
Massive collapse of lung	1	1
Peritonitis		2
Uncertain		2
Bile peritonitis due to injury to hepatic duct		1

* Excluding common duct cases.

† Excluding common duct and acute cases

IV. Acute Cholecystitis without Stones—Cases. Six of these patients (86 per cent) have been symptom free. One patient complained of pain and indigestion.

V. Common Duct Stone—5 Cases. Two patients (40 per cent) have been symptom free and three have had persistent symptoms as follows: one had attacks of pain, three indigestion, one jaundice and one had a fecal fistula.

SUMMARY

1. A ten-year survey of gallbladder surgery on the Fourth Surgical Division of Bellevue Hospital is presented.

2. Four hundred and ten cases of operation for gallbladder disease are reviewed, including a discussion of chole-

cystography, biliary drainage and blood chemistry.

3. Of 222 cases followed there was a symptomatic cure in 84 per cent of cases of acute cholecystitis, 70 per cent of cases of chronic cholecystitis with stones, 41 per cent of cases of chronic cholecystitis without stones. In the cases of common duct stone, the follow-up study showed no recurrence of pain or jaundice in 60 per cent of the cases.

4. We have found a special gallbladder clinic for the preoperative study and follow-up care of gallbladder patients most valuable.

5. X-ray findings were confirmed by operation in 84 per cent of 147 cases. A normal cholecystogram was found to be only 50 per cent reliable diagnostically.

6. Cholangiography has been added to our diagnostic procedures as a most valuable aid in the diagnosis of stones which have been overlooked.

7. Cultures of gallbladder wall at operation were positive in thirty-three out of sixty (55 per cent) cases, the most frequent organisms being *Bacillus coli*, *Staphylococcus aureus*, and *Streptococcus viridans*. Cultures of the fluid contents of gallbladders removed at operation were positive in 51 per cent. The organisms found in order of frequency were *Staphylococcus aureus*, *Bacillus coli*, *Streptococcus viridans*.

8. We regard biliary drainage as a necessary and important link in the diagnostic chain.

9. In 209 operated cases, in which biliary drainage was done, cholesterol crystals were present in 24 per cent of the cases, calcium bilirubinate in 16 per cent,

and both cholesterol and calcium bilirubinate in 17 per cent. When cholesterol crystals were present, stones were found at operation in 92 per cent. The presence of calcium bilirubinate in bile was associated with stones at operation in 79.4 per cent.

10. We have found the tilt table fluoroscope valuable in cases of unsuccessful biliary drainage.

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MALUNITED COLLES' FRACTURE*

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THE subject of Colles' fracture is old. The condition was recognized by few men before Colles' time and the importance of their articles went by unrecognized. About the year 1770, Pouteau, a distinguished French surgeon, specifically mentioned that fractures of the radius due to falls on the wrist, "are generally mistaken for sprains, for incomplete luxations, or for separations between the ulna and radius." This important statement might have been the seed for growth of our modern knowledge of this type of fracture but it carried no influence at the time. Nearly fifty years later A. Colles,¹ of the Royal College of Surgery in Ireland, wrote his classic on fractures of the carpal end of the radius. Even this, a clear, well described article would have gone by unnoticed had it not been for Robert W. Smith of Dublin who brought it into notice and enlarged upon it. Since that time such early writers as Malgaigne, Voillemier, Nelaton, Cooper and Fergusson contributed a great deal to the knowledge of Colles' fractures.

The first American publication on this subject was by John Rhea Barton in 1838. His writings were theoretical and doubted by many, but helped to stimulate a great deal of interest on the subject in this country. However, no articles were written until 1870, when E. M. Moore wrote a paper stressing the importance of injuries about the wrist. This was followed by a prize essay written by T. K. Cruse in 1874. In 1878, Pilcher contributed much to the practical and experimental details. He was followed by Packard² in 1879 who dilated upon the mechanics and treatment of this fracture. After that the contributions have been many and the strides great.

In spite of the fact that this subject has been written about so prolifically and the etiology and treatment have been covered so well, there still remains a good deal of haziness on the part of many of the medical profession not only as to the mechanics and misplacement of the fragments in these fractures, but also as to the normal alignment of the bones and the importance of their anatomical relations, as a result of improper reduction on the physician's part or due to the neglect of the patient in obtaining medical aid. Where the symptoms are marked and persistent, especially as occurs in older groups of individuals, surgical intervention should be carried out.

With the risk then of repeating what should be fundamental knowledge, the important points in the normal anatomy as well as those of the deformity will be reviewed.

In studying the normal relations of the distal ends of the radius and ulna in the lateral view, it will be noted (Fig. 1a) that a line drawn parallel to the long axis of the bones will form an acute angle ($A B' C$) with a line drawn tangent to the distal points of the radius (A and B), and that the distal joint surface of the radius tilts toward the anterior (flexor) surface of the forearm.

In a Colles' fracture with its impaction, posterior displacement and rotation posteriorly (dorsally) of the distal fragment (Fig. 1b) producing the characteristic silver-fork deformity, the angle ($A B' C$) becomes an obtuse angle.

In reducing this fracture, not only must the distal fragment be replaced anteriorly (toward the flexor surface), but it must be so rotated as to reform the acute angle ($A B' C$). Occasionally in difficult cases a right angle ($A B' C$) is all that can be ob-

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tained and fixed, and may be satisfactory, but in no case is an obtuse angle to be allowed to remain. This deformity so

The distal fragment of the radius (R) is closer to the level of the ulnar styloid (U) and may be proximal to it. (Fig. 1d.)

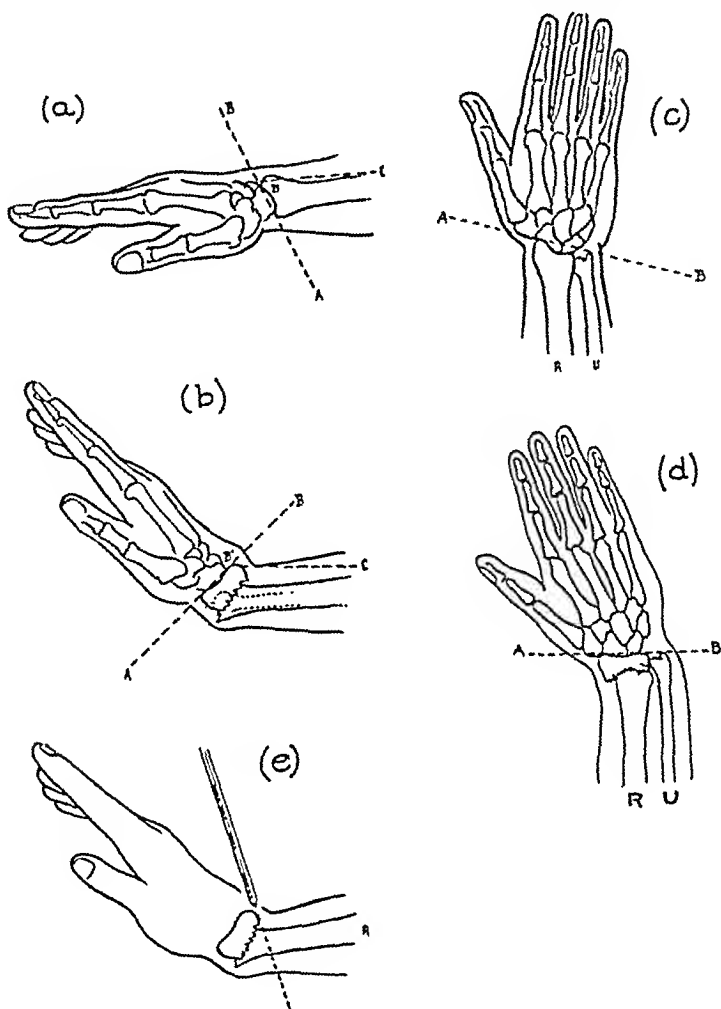


FIG. 1. a, normal wrist, lateral view; b, Colles' fracture, lateral view; c, normal wrist, anteroposterior view; d, Colles' fracture, anteroposterior view; e, correction of malunited Colles' fracture.

interferes with function that pain and disability are almost bound to persist. Successive attempts at anatomical reduction should be made until the proper acute angle (A B' C) is obtained.

In the normal anteroposterior view (Fig. 1c) the styloid process of the radius (R) is distal to the styloid process of the ulna (U). In a Colles' fracture (Fig. 1d) two important displacements occur and should be corrected: (1) The distal fragment of the radius and with it the styloid process of the ulna, if fractured, are displaced radially, i.e., toward the radial side of the wrist, giving the deformity toward that side. (2)

In order to assure a good result, it is necessary to replace the distal fragment of the radius distally (by traction), toward the ulnar side (by pushing it over) and to maintain it there until solid union has occurred. Hence the wrist and hand should be held in ulnar deviation, and kept there, for if the wrist be "turned loose" too soon, the common motion of bringing the hand toward the radial side, as in eating, may result in a recurrence of the radial deviation and a consequent deformity with prominence and pain over the distal end of the radius and ulna. In order to maintain the wrist in ulnar deviation the cast should be

so cut that the distal portion over the radial side and dorsal surface remains intact. This will hold the hand and wrist in

operation a posterior lateral longitudinal incision is made over the radius and across the fracture site. With a three-eighth inch



FIG. 2. Author's splint to prevent recurrence of radial deviation.

ulnar and palmar deviation, preventing recurrence of deformity. If a cast is not used, the author has devised a simple metal splint which will serve this purpose. (Fig. 2.) Most splints designed for the wrist are free on the radial side and have a straight edge on the ulnar side which tends to promote the radial deformity. This newly designed splint should prevent it.

Therefore, because many cases are either neglected or inefficiently treated, or both, poor results are obtained. Hence the mal-united cases occur and demand proper treatment.

In a patient with malunion, pain deformity and loss of function persist and require relief. Most of these cases, at least after six weeks, must be operated upon. Occasional early malunions can be reduced without open operation, either manually or by means of the Thomas wrench, but most cases with solid union require operative surgery.

TECHNIC

The technic which the authors use requires a sterile preparation preferably twenty-four hours in advance. At the

blade osteotome preferably, subperiosteally the radius is cut across the fracture site, slanting the surface slightly toward the palmar surface. (Fig. 1e.) The hand and distal fragment are then shifted to the ulnar and palmar side, which leaves a triangular bone defect over the radial and dorsal surface. This defect is then filled in by bone fragments either from the more proximal part of the radius or from the distal end of the ulna, if it is necessary to make an incision there.

If the ulnar styloid has been fractured or if it is prominent or painful, a second longitudinal incision is made over the distal end of the ulna and the styloid process or even the whole end of the ulna may be removed. This fragment can then be used to fill in the defect in the radius produced by the correction.

A posterior molded plaster splint is then applied over the radial and dorsal surface of the hand, wrist and forearm and allowed to harden in place. The splint is then fastened in place by means of a circular plaster. The plaster cast should extend from just proximal to the metacarpophalangeal joints, allowing the fingers and

thumb full motion, to the elbow. In some case the splint and cast are extended to include the elbow, especially in fat arms,

After two or three weeks or more the cast is taken off and slight motion instituted in the wrist joint. The cast is then

FIG. 3.



FIG. 4.



FIG. 3. Case 1. Malunited Colles' fracture.
FIG. 4. Case 1. Deformity corrected. (Note: Shortened distal end of ulna still too prominent.)

or when there seems to be a tendency for the replaced fragments to slip. The position after correction should be checked by two x-ray views, anteroposterior and lateral.

The cast in the case of corrected malunited fractures is left on at least two to three weeks without removing. It should be split down its entire length on the ulnar side if it is too tight because it disturbs the circulation, as is evidenced by swelling of the fingers, discoloration—either redness, blueness, or paleness—pain, prickling or numbness. If there is any question about it, the cast should immediately be split after applying.

reapplied and fastened on with adhesive tape. At frequent intervals thereafter, once every other day or so, this manipulation is done, reapplying the cast afterward. Gradually the frequency of the manipulation is increased. Soon a straighter cast or splint (Fig. 2) may be substituted for the flexed one, but the *ulnar deviation of the distal fragment* and hand should be maintained for approximately three or four months. The specially cut cast or designed splint should be used. Motion in the fingers and thumb should be encouraged *from the start*.

In these cases physiotherapy by means of gentle massage, properly given, long

wave diathermy, active and passive exercises, heat and contrast baths may be used to promote circulation, tone up the

the wrist was good in all directions, pain was gone and the deformity was reduced. On April 29, 1938, there was very slight pain on the



FIG. 5. Case III. Bilateral fractures, anteroposterior views.

muscles and limber the joints. Extreme care should be used at all times not to displace the fragments.

If this line of treatment is used in malunited Colles' fractures, a good result should be obtained.

For illustration three cases with four fractures so treated are here reported. All four fractures showed: (1) Constant pain located in the distal end of the radius and ulna, increasing on motion; (2) limitation of all motion at the wrist joint including flexion, extension and supination; (3) limitation of motion in the fingers; (4) marked weakness in the use of the hand; and (5) deformity.

CASE REPORTS

CASE I. M. Z., a white female, age forty-nine, fell January 28, 1937, sustaining a Colles' fracture of right wrist. The patient, thinking she had nothing more than a sprain, did not seek medical attention. Because of the persistent pain in her wrist she came to our clinic at Cook County Hospital in August, 1937. An x-ray taken revealed typical malunion of Colles' fracture. (Fig. 3.) Open reduction was done on September 14, 1937. (Fig. 4.) She was seen on October 28, 1937. Motion of

back of hand, all motion was present and there was no deformity.

CASE II. B. L., a white female, age sixty-eight, fell and injured her left wrist August, 1936. She did not get medical aid. When seen in our clinic September 28, 1937, she presented a marked deformity of the left wrist with difficulty in pronation and supination. Pain was persistently present in the wrist. An x-ray revealed malunion of Colles' fracture. Open reduction was done October 5, 1937. By November 20, 1937, the patient had good motion in her wrist, she was able to supinate and pronate forearm and all pain was gone.

CASE III. J. R., a colored male, age forty-one, fell injuring both wrists on August 20, 1937. His wrists became swollen and tender and since that date to September 21, 1937, when he was seen in the clinic, he was unable to move the wrists. An x-ray taken revealed bilateral Colles' fracture with malunion. (Fig. 5.) The fractures were reduced by open operation, September 28, 1937. Results were very good as to return of function and reduction of deformity.

SUMMARY

1. Malunited Colles' fractures are too common and result from neglect or inefficient care.

2. Pain, impairment of function and deformity will usually persist if the malunion is not corrected.

3. Correction often requires open operation.

4. Posterior tilting and radial deviation are especially to be guarded against.

5. Most cases can be improved.

6. A new splint is suggested.

7. Three cases so corrected are reported with good results.

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THE thumb is the most valuable member of the hand because of its ability to oppose all other fingers either separately or together. It is worth almost as much as all other fingers put together.

From—"Surgery of the Hand"—by Couch (University of Toronto Press).

SOME OBSERVATIONS ON ENDOMETRIOSIS*

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IN the paragraphs which follow there will be presented some of the observations and experiences of the surgical staff of the Woman's Hospital with endometriosis, together with brief comments on the same subject in the abstract. In referring to the work of other investigators and in quoting from the literature on this subject, it is fully realized that ground already familiar to many will be retrodden. In the period of ten years which ended 1937 the pathologists, after gross and microscopic study of tissue removed at operation, returned a diagnosis of endometriosis in 361 different patients and in many individual and combined locations. In 226 of the cases, however, the particular form of endometriosis encountered was adenomyosis interna or islands of ectopic endometrial tissue in the myometrium. They were discovered only in the course of routine pathological examination in patients on whom a hysterectomy had been performed for one reason or another, were scarcely if ever recognized by the operating surgeon and were not productive of clinical symptoms. Most of these uteri were removed primarily for fibromyomas and a considerable number were the result of vaginal hysterectomy for procidentia, an operation much in favor with our staff before the present wide use of parametrial fixation. For obvious reasons these cases, although they make up about 60 per cent of the total, do not belong in a clinical review of endometriosis. The critical analysis, therefore, will be limited to the cases in which endometriosis was the sole or a prominent contributory cause of the symptoms from which the patient sought relief.

DEFINITION AND NOMENCLATURE

It is difficult or impossible to formulate in a few words a comprehensive definition of endometriosis for, as Graves has said, the subject is one which is encumbered with a profusion of ill fitting terms. These various appellations are doubtless the result of a repeated application of new names as increased knowledge of the subject has been acquired over the past thirty years beginning with Cullen's masterful treatise on adenomyomas of the uterus in 1908. For the sake of simplicity the term endometriosis should be used to include all pathologic lesions, most often found in the female genital tract, which are the result of heterotopic or misplaced endometrial tissue. Other terms which may be found in the literature are adenomyosis interna and externa, adenomyomatosis, mulleriosis, adenosis, endometrioma and, in the case of the ovary, chocolate, tarry and hemorrhagic cyst. All of these lesions are endometriosis and it seems to the writer that the latter term alone is sufficient, adding in each case the area affected or the organ involved. Strictly speaking, the suffix "oma" appears to be a poorly chosen term in these cases, whether it be in connection with adenomyoma or endometrioma, for it implies true neoplastic development. Since it is now almost universally agreed that these heterotopic growths are of endometrial origin and, furthermore, that their mode of dissemination has been as Sampson described, the suffix "osis" becomes much more appropriate and, by its inherent meaning, correct.

There is, of course, a place elsewhere for the term adenomyoma which is a mixed

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tumor of the uterus characterized by true neoplastic development of both glandular and muscular tissue growing side by side. An adenomyoma is a rare tumor, most often round, sharply defined and enucleable and the chief interest in it lies in the histologic structure. Clinically, it is almost impossible to distinguish it from the ordinary myoma, so frequently encountered in gynecological surgery.

HISTOLOGICAL

One of the earliest contributions to the subject of endometriosis, as we now know it, appeared in 1860 when Rokitansky published his observations on adenomyomas of the uterus. Other foreign authors, among them von Recklinghausen, Pick and Meyer, made valuable observations but in this country the evolution of our knowledge of the subject will always be associated with the names of Cullen, of Baltimore, and Sampson, of Albany. Any student of this condition must familiarize himself with the writings of these two observers, Cullen having begun as far back as 1896 with a paper on adenomyoma of the uterine ligaments and Sampson having produced a series of brilliant essays at short intervals through the nineteen twenties. Other authors who have presented their observations in recent years are Keene and Kimbrough, Davis, Dougal, Wharton, Pemberton, Masson, Counseller and the French gynecologists, Cotte and Mathieu.

When Sampson's first paper on endometriosis appeared, great interest was stimulated in the subject. His ingenious theory of retrograde transtubal implantation stands out as one of the major contributions to gynecological literature in modern times. For the ten or twelve years following Sampson's earlier publications no subject in gynecology received more spirited discussion, and interest in it has been maintained remarkably well to date, even though there is no longer the sharp controversy about various theories that once existed.

ETIOLOGY

A number of theories have been formulated to account for the presence of endometrial tissue or tissue closely resembling endometrium elsewhere than in the cavity of the uterus itself. These hypotheses may be found in any of the more recent textbooks on gynecology or pathology and need not be recounted in detail here. Seven or eight of them have appeared from time to time and brief reference will be made to five of them, as follows:

The first of them may be called the mucosal invasion theory and presupposes a direct invasion of the myometrium by uterine mucosa or a similar invasion of the wall of the tube by its mucosa. Endometriosis of the uterus itself (adenomyosis interna) and of the tube may be explained on this basis but lesions in the ovary, uterine ligaments and other adjacent or distant organs are, by the same token, much more difficult to explain. With this theory are closely associated the names of Cullen and von Recklinghausen whose publications appeared around the turn of the century.

A second theory may be designated the Muellerian theory wherein it is postulated that the various lesions of endometriosis are due to inclusions of Muellerian rests. A Muellerian origin for an adenomyoma of the right round ligament was suggested by Cullen in 1896 and three years later Russell reported in the John Hopkins Hospital Bulletin a case of heterotopic endometrium in the ovary, attributing its origin to an aberrant portion of the duct of Mueller. Russell's paper has been rather widely quoted and many writers, among them Blair Bell, gave his conclusions support. It is pointed out that there is a close anatomical proximity between the Muellerian duct and the anlage of the ovary and that the celomic mesothelium is the precursor of both. It is argued, therefore, that an interchange of cells from one anlage to the other might easily take place and, as Russell stated, a portion of germinal

epithelium, which forms the ovary, might produce structures which its function elsewhere calls upon it to do.

The third of these theories is known as Wolffian, wherein the lesions are ascribed to adult remains of the Wolffian tubules. With this hypothesis is associated also the name of von Recklinghausen who formulated it. He observed that growths containing endometrial tissue were frequently found in the posterior wall of the uterus and near the isthmic portion of the Fallopian tubes and that these areas were the same in which remains of the Wolffian tubules are most frequently found. Later he expanded his theory to account for involvement of the uterine ligaments and other adjacent sites and for quite a time his beliefs were accorded more or less general acceptance, only to be superceded later by the mucosal invasion theory.

The fourth or serosal theory of origin contends that the lesions of endometriosis result from the metaplasia and subsequent growth of the endothelial cells of the peritoneum. There are a number of observations which show that the peritoneum or the germinal epithelium of the ovary, under certain influences of inflammation or of unusual endocrine disturbances, can alter the character of their respective latent cells and take on an entirely different appearance. With this theory the names of Ivanoff, Meyer and Pick have been prominently associated, the latter being among the first to describe the typical chocolate cysts of the ovary which he called *cystoma ovarii endometroides*. Almost all of the German writers have supported this theory at one time or another and Novak has been a staunch advocate of it in this country. The latter, however, has favored a hormonal influence, rather than an inflammation, as the cause of metaplasia and hypertrophy of the celomic mesothelium.

The fifth and last theory of origin to which reference will be made is the one formulated by Sampson and it has received the widest acceptance of all. It may be called the transtubal implantation

theory and this appropriate name immediately suggests the nature of the process involved. As a result of extensive combined clinical and laboratory investigation Sampson showed that detached endometrium or tubal mucosa may become implanted elsewhere, such as on the ovary, the uterine ligaments or the peritoneum covering adjacent intestine, the posterior surface of the uterus and particularly the posterior cul-de-sac. This detached epithelium escapes or is regurgitated through the tubes at the time of menstruation or, less frequently, during the course of some gynecological manipulation, either examination or operation. This transplanted tissue has a histologic structure which is identical with that of the uterine mucosa and, as it penetrates the surfaces on which it becomes lodged and grows, it is governed by its own inherent physiological laws in its reaction to menstruation, pregnancy and the menopause. Sampson gives a number of plausible reasons to support this theory that the various lesions of endometriosis are the result of true peritoneal implants derived from epithelium carried backward through the tube with menstrual blood. He points out that their structure and function are the same as the uterine mucosa and that they develop only in women during their menstrual life. He has observed blood escaping from the fimbriated ends of tubes of women operated upon during menstruation and has examined this material microscopically, finding that this blood shows epithelial cells and fragments of endometrial stroma. The early implants are most frequently found on structures which are in close anatomic relation with the fimbriated ends of the tubes and are often in various stages of development in the same individual, thus suggesting repeated implantations from the original source or from other endometrial foci in the pelvis. The tubes are usually patent, the deposits are usually multiple and scattered and similar growths have been demonstrated in the scars of abdominal incisions in cases in which it was possible to contaminate the

field with uterine or tubal tissue, such as in cesarean section. Furthermore, lesions similar to endometriosis have been reproduced in the experimental laboratory by Jacobson who transplanted fragments of uterine mucosa into the peritoneal cavity of the rabbit.

It may be appropriate here to refer briefly to the editorial comment on endometriosis by Meigs which was published in *Surgery, Gynecology & Obstetrics* a short while ago. He admits the plausibility of Sampson's theory of reflux of endometrium through the tubes but prefers that of serosal metaplasia and then goes on to stress late marriage and contraception as important etiological factors in the production of endometriosis. Long postponement of conception allows an unduly long and uninterrupted menstrual life and this, in turn, results in excessive stimulation of the unutilized celomic cells by the various hormones. The stimulation of these celomic cells next causes them to take on Muellertian or uterine characteristics and thus endometriosis is produced.

PATHOLOGY

The pathology of typical misplaced endometrial tissue has been well summarized by Davis who quotes from the classical papers on the subject and emphasizes that it is governed by the same physiologic laws, in its reaction to menstruation, pregnancy and the menopause, as the mucosa lining the uterus. Wherever the situation may be, these reactions continue to go on and periodic swelling and discharge of blood occur even in endometriosis of the rectovaginal septum, the umbilicus and laparotomy scars. By the same token, decidual reaction during pregnancy is found in the stroma underlying ectopic endometrium and atrophy of the glandular structures in endometriosis occurs after the cessation of the ovarian function.

The ovary takes first place as a host or incubator for the development of endometriosis when the subject is considered clinically, although small asymptomatic

lesions in the myometrium generally (adenomyosis interna) and in the cornual areas surpass the ovarian implants numerically. Ovarian endometriosis appears grossly in the form of hematomas which vary in size from pin head superficial lesions, involving only the surface layers of the organ, to the large tarry or chocolate cysts which may reach such diameters as to be palpable as masses on bimanual examination, like cysts of the ovary or fibromyomas within the layers of the broad ligament. The smaller lesions are multiple and appear as minute red or purplish deposits on the surface of the ovary, the color being dependent upon the age or the time in the menstrual cycle. The beautiful colored illustrations in Sampson's papers depict them almost as vividly as in the living subject. They are more often bilateral than unilateral and when they perforate, as they probably often do under the influence of menstruation, they become adherent to the surrounding structures. The larger endometrial hematomas appear to have their origin deeper within the substance of the ovary and do not perforate as early as the smaller deposits on the surface. When perforation occurs the ovary becomes densely adherent to the adjacent structure, whether it be the posterior layer of the broad ligament, the bladder, the opposite ovary, the appendix, the rectosigmoid, the uterus itself or the small intestines. The adherent structures now become a part of the wall of the newly formed hematoma and seal off the latter. In attempting to free the ovary at operation the site of perforation is almost invariably reopened and the typical chocolate colored contents of the cyst are liberated. While this process is not a malignant one in the true histologic sense, nevertheless there is a real invasion of healthy tissue which results in such dense adhesions that the pelvic viscera become tenaciously matted together and lines of cleavage often become difficult or impossible to establish. In our Woman's Hospital series the ovary was involved alone in fifty-four of the 135 clinical cases of endo-

metriosis and in conjunction with lesions in the uterus, tubes, ligaments and rectovaginal septum in an additional thirty-two cases, making practically two-thirds of the total. Thus the ovary becomes the most favorable site for the development of ectopic endometrial growths, a sort of incubator, as it were, and may be a permanent or, in the case of rupture, an intermediary host.

Another frequent site of endometriosis is the posterior cul-de-sac and rectovaginal septum in which location the implants result in a fusion of the anterior wall of the rectum with the posterior wall of the cervix. For many years these and closely similar lesions have been designated adenomyomatosis or simply adenomyomas and Cullen has classified them in three distinct categories: He has placed those lying free in the septum in one group, those adherent to the posterior wall of the cervix and the anterior wall of the rectum, often fusing the two, in another group and those forming a dense mass of cervix, rectum and broad ligaments into a third group. Microscopically these lesions in and about the rectovaginal septum present the typical picture of endometriosis of the ovary with small cysts and gland spaces filled with the familiar chocolate contents. Clinically, they may be palpated as discrete or diffuse nodules involving the vaginal vault and the adjacent cervix and rectal wall. On the vaginal side they may sometimes be viewed through the speculum as red or bluish indurated cysts which at times perforate and discharge their contents during menstruation, a phenomenon which rarely, if ever, occurs when the rectal wall is similarly involved. In our series of 135 cases there were four which had involvement of this region as the only grossly discernable endometriosis in the pelvis, although three others were described as having affected the contiguous cervix alone, one of the latter in the stump following low amputation. Besides, in a score or more of other cases, small deposits of endometriosis were noted deep in the posterior cul-de-sac

when the main lesion was in the ovary, uterus or uterine ligaments.

Other less favorable sites for the development of endometriosis are the round, the utero-ovarian, the infundibulopelvic and the uterosacral ligaments. Of these the round ligament is most often involved and the lesions may be demonstrated in the intraperitoneal portion, the portion within the inguinal canal and the distal portion in the labium majus. The clinically designated inguinal endometriosis comes within this category and the swellings may at times attain considerable size, although they more frequently are palpated simply as small nodules. They increase in size and become more painful with the advent of menstruation just as the lesions in the ovary respond to these physiological laws. Due to its more remote situation from the fimbriated ends of the tubes, there is even more controversy over the origin of inguinal endometriosis than in the case of the ovarian type. Here the theory of development from ectopic Muellerian or Wolffian tissue becomes more tenable and some have held that endometrial cells reach the inguinal regions via the lymphatics or venous channels. In only two of our 135 cases was endometriosis of the uterine ligaments the symptom producing lesion for which operation was performed, although small deposits were found on the round and uterosacral ligaments in many of the ovarian and combined cases.

Besides the structures mentioned so far, the pelvic peritoneum, the serosa covering the sigmoid and small intestines, the umbilicus and laparotomy scars have been observed as sites of growth of ectopic endometrial tissue. Many of our combined cases showed involvement of the peritoneum, one appeared in a laparotomy scar following cesarean section and there were two cases of endometriosis of the umbilicus. The umbilical growths appear as small nodules in that region which undergo swelling, intensification of color and tenderness during menstruation and on section reveal the same histologic picture as intrapelvic

endometriosis. As in the case of inguinal endometriosis, these umbilical lesions are not easily explained by the implantation theory of Sampson and more speculation has arisen about their origin. Perhaps in this instance the serosal metaplasia theory again becomes more tenable. In practically all cases of endometriosis of laparotomy scars, the operation had involved manipulation of the uterus and the transfer of detached endometrial or tubal mucosa to the involved area. These cases seem admirably suited to the implantation theory and Danforth has proposed several ways in which this might occur. He mentions the forcing of endometrium through the tubes by pressure on the uterus during operation, the escape of endometrium during cornual excision, myomectomy, hysterectomy or cesarean section and also the transfer of endometrium by the needle and suture in the course of performing a ventrofixation.

AGE INCIDENCE AND PREVIOUS OPERATIONS

As many students of this subject have pointed out, endometriosis is an affection that is observed during the menstrual or reproductive period of life and our experience at the Woman's Hospital has proved no exception to this rule. None of our patients was under twenty and only twenty-nine of the 135 were less than thirty years of age. An even hundred of the patients were in the fourth and fifth decades of life, about equally divided between those in their thirties and those in their forties. Only five were in their fifties and but one of the entire group was over sixty at the time of observation. Many of ours in the older groups had hysterectomies for concurrent fibromyomas and the treatment was relatively simple, a fact which obviously did not hold for the women in their thirties in whom the preservation of menstruation and child bearing function was of paramount importance.

Sampson has pointed out the potential danger of initiating endometriosis by manipulation of the pelvic viscera in

examination and at operation. He believes that endometrial tissue may be squeezed or spilled out of the fimbriated ends of the tubes in this manner, just as in the case of reflex during menstruation. In this connection it may be of significance that fifty-three or nearly 40 per cent of our patients had been operated upon previously. Of these, forty-one had laparatomies for one condition or another, including cesarean section, before coming to us and twelve gave a history of vaginal plastic work or curettage.

ASSOCIATED LESIONS

The student of endometriosis soon discovers that almost no other affection of the female genital tract is so often associated with other pathologic lesions and so infrequently appears alone and uncomplicated. This fact accounts largely for the difficulty the clinician experiences in recognizing the symptoms and diagnosis of this disease. As stated in the beginning, practically two-thirds of the Woman's Hospital cases were diagnosed by the pathologist after operation, rather than by the clinician, because the lesions were found in the laboratory on routine examination of fibroid uteri and other such specimens. Clinically, they were asymptomatic and excluded from this study. In the remaining third, 135 cases, which was analyzed, the ectopic endometrial lesion was grossly discernable at operation, was productive of clinical symptoms and often definitely diagnosed or strongly suspected before operation.

Even these cases showed, almost without exception, association with other pathologic lesions. The ovarian, tubal and combined endometriosis cases were practically always complicated by fibromyomas, chronic salpingitis, adherent retroversion or dense peritoneal adhesions. Only one of our four rectovaginal septum cases stood out as an uncomplicated entity, two of them being associated with multiple fibroids and adenomyosis interna and the fourth with an adherent retroversion. The cases in which the uterine ligaments were

chiefly involved were likewise complicated by chronic salpingitis retroversion and fibroids but the umbilical cases, on the other hand, were limited to that area.

SYMPTOMS AND DIAGNOSIS

The symptoms of endometriosis are by no means characteristic and no single symptom or sign may be regarded as peculiar to the lesion or pathognomonic. This is largely due to two quite obvious conditions. In the first place endometriosis may occur in any one of several different organs or in a combination of two or more of them and, as a result, the symptoms will depend upon the particular organ affected and its location. Again the symptoms are frequently produced, modified or obscured by the associated inflammatory or neoplastic disease or by the malposition of the uterus which is so often a complication.

Many writers on this subject point to dysmenorrhea, particularly the acquired type, as one of the most characteristic symptoms of the disease. Dougal held this opinion, although he admits that it was present in somewhat less than half of his cases. He states that the pain is progressively severe in intensity and may be referred to the side on which the ovary or the uterine cornu (endometriosis of the tubal angle or salpingitis isthmica nodosa) is involved. He and other English writers have held that cornual endometriosis may be an important cause of pain in one or both iliac fossae at the time of menstruation. Keene and Kimbrough found dysmenorrhea in about half of their cases and much the same figures hold for the large series from the Mayo Clinic recently reported by Counsellor. It did not appear to be so prominent a symptom in our series in which only 6 per cent of the patients came solely for the relief of dysmenorrhea. It was one of a combination of symptoms, however, in many other cases.

Abdominal pain, constant, irregular or aggravated by menstruation and excessive or irregular menstruation are the symptoms for which most patients with intra-

pelvic lesions consult the physician and these are likewise the prominent symptoms of endometriosis as we found them. Over half of our patients sought relief from either abdominal pain or menstrual disturbances and nearly all the rest presented a combination of these as their chief complaints. In the combined group many had dysmenorrhea but it was not often the predominating feature of the case. A few complained of backache, swelling of or bleeding from the umbilicus, bleeding from a laparotomy scar, abdominal swelling, dyspareunia and rectal tenesmus, according to the organ or area affected.

Sterility is often recorded in taking the histories of these patients, although very few of ours came primarily for relief of it. Of the 135 patients analyzed, seventy-six were nulligravidas and fifty-nine had been delivered of from one to five full-term children. Nine others gave histories of abortions or premature labors and one woman's only pregnancy resulted in an operation for ectopic gestation.

The preoperative diagnosis of endometriosis is difficult at best in the majority of cases and the entire clinical picture is more apt to suggest the diagnosis, rather than any individual symptom or physical sign. Most of the patients are in their thirties and forties, or at least over twenty-five, and complain of lower abdominal pain or backache associated with dysmenorrhea and other abnormalities of menstruation. Half or more of them are sterile and a relatively high percentage suffer with dyspareunia or rectal tenesmus or both.

Like the symptoms, the objective findings depend entirely upon the location of the lesion and a mass may be palpated in the case of a hematoma of the ovary or gross cyst formations in the cul-de-sac and rectovaginal septum. The uterus is frequently in the retroverted position and is relatively or absolutely fixed by the dense peritoneal adhesions nearly always present. Nodules on the posterior vaginal wall high up behind the cervix may be palpated or

viewed through a speculum. Involvement of special areas, such as the inguinal region, laparotomy scars or the umbilicus are, of course, more easily recognizable.

TREATMENT

The treatment of endometriosis should be surgical excision of the lesion and, since it is frequently a disease of comparatively young women in whom ovarian conservation is desirable, the question of how much to do becomes a most perplexing one. In the older patients, in whom ablation of the ovarian function does not matter so much, roentgenotherapy or radium irradiation may be employed in addition to radical surgery but most writers report only 2 or 3 per cent of their patients treated by these methods. We have had no experience with radiotherapy for endometriosis at the Woman's Hospital, although we recognize with others that ovarian function is essential to the growth of ectopic endometrial tissue and that cessation of the former results in regression and extensive atrophy of the growths. To conservative operative work some surgeons have added presacral nerve resection as a prevention against pain in the event of recurrence of the trouble but to most it seems of dubious practical value.

As to the question of conservative versus radical surgery in these cases, the writer is convinced on general principles that an effort should be made to save as much ovarian tissue as possible for women in the younger age groups. Small cysts and implants on the ovary and elsewhere on the pelvic peritoneum can be excised or destroyed with the cautery and malpositions of the uterus can be corrected after separation of the adhesions which anchor it in the cul-de-sac. By so doing the menstrual and sometimes the child-bearing function of the patient can be preserved for her and she is saved the distressing symptoms which characterize an early artificial menopause. On the other hand, more extensive lesions, particularly those which involve both ovaries, can be remedied only by more radical procedures and a supravaginal

or total hysterectomy combined with the removal of both appendages gives the best results. With very few exceptions, if any, the ablation of the ovaries will bring about a regression and atrophy of endometriosis in the rectovaginal septum and in other places where possible injury to the bowel might be involved in removing it.

In the Woman's Hospital group the ratio of conservative to radical operation was exactly 5 to 4 and by radical is meant the complete removal of all ovarian tissue. Of the seventy-five patients who underwent conservative operation, forty-two left the hospital with enough of the genital tract intact to make pregnancy a possibility while thirty-three were rendered sterile by hysterectomy, the removal of both tubes or various combinations of work.

The postoperative morbidity and the immediate mortality rate are slightly greater in these cases than in a random series of gynecological laparotomies for other conditions, such as operations for fibromyomas, ovarian cysts or retroversion. This is due, of course, to the wide blunt and sharp dissection of dense peritoneal adhesions often required, the spill of the tarry material from the old cysts, the longer time consumed, the greater tendency to hemorrhage and shock, the disruption of integrity of the serosal or muscular layers of the bowel and the general trauma which accompanies extensive manipulation. Three of our patients died while in the postoperative stage, slightly over 2 per cent, and all of them showed signs of peritonitis with marked distention and ileus.

SUBSEQUENT COURSE

It is the custom in our clinic to observe patients at stated intervals for a year or more after operation and they are classified as satisfactory, partially satisfactory or failures in the light of relief of the symptoms for which they originally entered the hospital. On this basis practically all of the radical cases were satisfactory and secured complete relief from the distressing symptoms for which they consulted the surgeon.

The incidence and intensity of artificial menopause symptoms in this group were no greater than in other cases in which bilateral oophorectomy is done.

In the conservative group only four out of seventy-five were classified as complete failures and upon all of these subsequent radical operations were performed. The satisfactory cases in this entire group were close to 75 per cent, leaving only about one patient out of four who was not completely relieved of her original complaint of pain, menstrual disturbance, dyspareunia or other symptoms which she had, either alone or in combination, on admission.

Four of the forty-two patients who were left with enough organs to make pregnancy a possibility conceived and were delivered of one or more full-term children after operation, so far as is known. Others who failed to continue under observation may have become pregnant but probably not many of them. This is slightly less than 10 per cent and not quite as good as the seven out of fifty-five who became pregnant in Counseller's series. Conservative operations for endometriosis do not, therefore, seem to yield very gratifying results so far as subsequent fertility is concerned.

By way of comparison with the figures of this series, the writer would like briefly to refer to a significant study of clinical aspects of endometriosis by Cotte and Mathieu of Lyons made a year or so ago. They reported on seventy-eight cases of endometriosis, confirmed by microscopic examination, and were opposed to the radical operative measures advocated by some gynecologists. In over half of their cases, conservative operations sufficed. The administration of ovarian substance only aggravates the symptoms. One should be very sure of the diagnosis before beginning radiotherapy, as premature castration, if the diagnosis were wrong, would be very regrettable. In cases of endometriosis with multiple localizations, bilateral oophorectomy is indicated. Hysterectomy should be done only if there is an associated lesion in the uterus. Rectovaginal adeno-

myomas are especially serious localizations of endometriosis. They have had very good results following subtotal hysterectomy with removal of both tubes and ovaries. For the peritoneal forms as associated lesions it suffices to treat these lesions. If the treatment is not successful, more radical measures are indicated. For localized adenomyoma of the uterus, resection can still be done, but if the lesion is diffuse only hysterectomy can be considered. With unilateral tubal endometriosis, only the involved tube should be removed and, in cases of bilateral involvement, the uterus and one ovary should be conserved. With unilateral or even bilateral ovarian endometriosis, every effort must be made to conserve at least a part of an ovary.

SUMMARY AND CONCLUSIONS

The subject of endometriosis has been reviewed and reference has been made to the 361 patients who presented such lesions in the Woman's Hospital in the past decade. An analysis of only 135 of these, about 40 per cent of the total has been undertaken, as a majority of our diagnoses were returned only by the pathologist and were made on cases in which endometriosis complicated some other more important condition and had no clinical significance of its own.

In appraising the various theories of the mode of origin of endometriosis, the author believes very strongly that the transtubal implantation theory of Sampson is the most satisfactory and that it should receive the general acceptance of the profession in most cases. There are not many situations in which the metaplasia of serosal cells or the growth of Wolffian or Muellerian rests can be offered as better solutions to the problem.

Endometriosis may on rare occasions be found as an isolated lesion in the groin, the umbilicus, the scar of a laparotomy wound or elsewhere. In most cases, however, it is associated with or appears as a complication of some inflammatory or neoplastic condition of the uterus or its appendages,

or is the factor responsible for the adhesions anchoring a retroverted uterus to the structures behind it.

The symptoms of endometriosis depend almost entirely on the organ or areas involved and, in our experience, were rarely typical. Women with endometriosis seek relief for the most part from abdominal pain, backache and menstrual disturbances, just as do those who suffer with tumors, inflammatory disease or malpositions of the pelvic viscera. Dysmenorrhea, which is stressed by several writers as almost pathognomonic of the disease, was the sole or outstanding complaint in relatively few of our cases, although a majority stated that their symptoms were frequently aggravated at the time of menstruation.

About 40 per cent of our patients gave a history of previous operations on the genital tract, comprising laparotomies, vaginal plastic operations and curettements. The ratio of nulligravidous women to those who had had full term pregnancies or abortions was roughly 5 to 4 and only rarely did a woman come chiefly or solely for the relief of sterility.

We have had no experience with resection of the presacral nerves in these cases nor with radium or roentgen rays. All our treatment was operative and the radical operations gave satisfactory end results, almost without exception. It is probably wiser to be a little more radical in these than in the average run of gynecological cases because very few will become pregnant again and because symptoms are liable to persist as long as ovarian tissue remains. No hard and fast rules can be laid down for treatment because the patient's

age, her history and the location and extent of the diseased condition are all factors in arriving at a decision as to how much to do.

CHIEF COMPLAINTS

Menorrhagia and metrorrhagia	41	Leukorrhea	2
Multiple symptoms	41	Bleeding from umbilicus	2
Abdominal pain	31	Prolapse	2
Dysmenorrhea	9	Bleeding from cesarean scar	1
Backache	5	Dyspareunia	1

LOCATION OF PATHOLOGY

Ovaries	54	Cervix	3
Combinations	32	Umbilicus	2
Tubal angles	27	Uterine ligaments	2
Tubes	9	Laparotomy scar	1
Rectovaginal septum	4	Groin	1

PREVIOUS OPERATIONS

Abdominopelvic	40
Vaginal, including curettage	12
Cesarean section	1
A few others had breast surgery or other irrelevant work	

CHARACTER OF OPERATION PERFORMED

Pregnancy possible	42
Pregnancy impossible but ovarian function preserved	32
Both ovaries removed	60
Roentgen ray castration	0
Radium castration	1

AGE INCIDENCE

Under 20	0	40 to 49	49
20 to 29	29	50 to 59	5
30 to 39	51	60 or over	1

PREVIOUS PREGNANCIES

None	76
Abortions only	7
Premature labors only	2
Full term pregnancies	59
Ectopic pregnancies	1

END RESULTS

	Per Cent
Satisfactory	83
Partially satisfactory	14
Failures*	3

* The failures, four in all, had conservative operations and were operated upon again.



MULTIPLE PRIMARY MALIGNANT TUMORS

REPORT OF TWO CASES

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THE coexistence of multiple primary malignant tumors was reported first by Billroth in 1869.¹ At present the literature on the subject represents the observations and studies of 445 authors all but eighteen of whom were content in submitting one to several case reports. The frequency with which present day surgeons and pathologists record the concurrent existence of two or more cancers in the same individual tends to make the condition appear quite commonplace. It is conceded that a multiplicity of primary malignant tumors no longer constitutes a biological curiosity. Only those whose experience with malignant disease is limited are exercised by encountering such multiple pathological entities.

Prior to 1931 cases of multiple malignancy were reported in series from eight European sources. These contributions were made by von Hansemann⁴³ and Feilchenfeld⁷ in 1904, Redlich³³ in 1907, Gade¹⁰ and Harbitz¹⁴ in 1916, Reichelman³⁴ in 1926, Puhr³² in 1927 and Ward⁴⁴ in 1930. During that period, also Major²⁵ and Orr²⁹ presented series of case studies in the American literature. Their material was gathered mainly from foreign sources. Owen,³⁰ in 1921, reported 143 cases of multiple cancers, the majority of which were either of squamous or basal cell type. In 1931, Hanlon,¹⁶ working at the Mayo Clinic, thoroughly reviewed the literature and reported forty-eight additional cases.

In comparatively recent years case reports of multiple primary malignancies have been made by Judd and Phillips,¹⁹ Mayo and Zellhoefer,²⁶ Friedman and Golden,⁹ Pemberton and Waugh,³¹ Greenwood,¹³ Smith,⁴² Eisenstaedt,⁵ Kretschmer and Heckel,²² and others.^{20,23}

GENERAL INCIDENCE

Authors who have reported larger series of multiple cancers are generally agreed in that these tumors occur more frequently than can be explained by the factor of chance alone and that the actual incidence exceeds the reported incidence by several per cent.

Bilello and Montanini,² in reviewing 8,024 autopsies found only seven multiple cancers among 1,154 malignancies, an incidence of 0.5 per cent. Goriainowa and Schabad¹² reviewed 6,652 necropsies, 1,238 of which revealed malignancies, twenty-three multiple, an incidence of 1.8 per cent. Warren and Gates,⁴⁵ who published the results of a comprehensive survey including all cases reported between 1869 and 1932, to which they added their own series of forty cases, making a grand total of 1,259 cases, computed the incidence of multiple malignancies among all malignancies on the basis of collected statistics at 1.84 per cent. On the basis of American statistics alone, they computed the incidence at 3.9 per cent, and at 3.7 per cent in their own series. In a study made at the Mayo Clinic in 1929 and reported by Hurt and Broders¹⁸ in 1933, seventy-one multiple cancers were observed in a series of 2,124 malignancies. From this information the conclusion was drawn that, although the statistical incidence was 3.34 per cent, the actual incidence was probably more nearly correct at 4.0 per cent because it seemed "reasonable to assume that about fifteen of the 2,053 patients with single malignant tumors seen in 1929 will, at some time later than 1931, have another primary malignant tumor."

Schreiner and Wehr,³⁶ in 1934, reported their experience between the years 1913 and 1933, a period during which 11,212

malignant lesions were observed. Among these there were 307 cases of multiple malignancies, an incidence of 2.7 per cent. Bugher,³ later the same year, reviewed 4,394 autopsies in which death was attributable to cancer in 983 instances. In thirty of his cases multiple malignancies were present, an incidence of 3.1 per cent.

Burke⁴ in 1936, reported the highest proportion of multiple cancers, 7.8 per cent, found in any series. He found forty-six multiple malignant lesions among 2,033 necropsies in which there was a total of 583 cancers. In explanation of the unusually high incidence among his cases, Burke calls attention to the fact that his studies were made during a very recent period, 1924 to 1935, when the recorded cancer mortality rate of the United States showed a steady rise, and that his figures were computed from postmortem series in which all the organs and tissues were subjected to careful microscopical examination.

The most recent report of multiple malignant tumor cases was made by Kirschbaum and Shively²¹ in December, 1938. In a study of 10,870 consecutive necropsies they discovered twenty-five multiple cancers, an incidence of 1.77 per cent.

A cursory review of the literature reveals a wide variation in the incidence of multiple primary malignant neoplasms. In certain series the frequency is found to be as low as 0.3 per cent,³² while at the other extreme it is observed to be 7.8 per cent.⁴ Ratios usually range between 1 and 5 per cent. This statistical confusion is attributable to many factors.

SOURCES OF INCIDENCE VARIATION

In larger necropsy series there appears to be an abnormally low incidence as compared with smaller series which take into account total (morbidity and mortality) multiple cancer cases; and there is a marked variation in the percentage of multiple cancers found among all autopsies in comparison to the number found among autopsies in malignant cases alone.

Broad discrepancies result from the lack of standardized criteria. Lesions which are multicentric in origin, such as Hodgkin's disease—certainly not a cancer—cancer of the liver and multiple myeloma, when included, make for an upward trend in the incidence. The inclusion of bilateral cancers or those which occur in paired organs, as observed in the breast, kidneys and ovaries, produce a similar rise. The addition of cases in which there are multiple malignancies in the same organ or system, the skin, breast, stomach, liver and colon, likewise raises the incidence.

Tumors in the brain, some of which are histopathologically benign but clinically malignant, are occasionally reported as examples of multiple malignancies; but their individual rarity permits of only meager influence in raising the general proportion of multiple cancers.

To an appreciable degree, statistics are governed by their source. Those derived from the accumulated records of hospitals are likely to show a much higher incidence of multiple cancers than will those derived from individual experience. This is particularly true in the case of tumor clinics and cancer institutes. From these the figures may be misleading because of the greater concentration of cancerous patients. The personnel of hospitals devoted primarily to the diagnosis and treatment of neoplastic diseases is undoubtedly more keen in recognizing the coexistence of multiple cancers. Not infrequently less skilled physicians erroneously consider one primary cancer the metastasis of a coexistent separate primary malignant neoplasm without subjecting either to microscopical examination.

In so-called general hospitals it is the tendency to perform autopsies for the purpose of disclosing gross pathological lesions in organs of particular interest. In consequence, many occult cancers are missed, as may be gathered from reports on necropsies in which all tissues are subjected to minute study.^{27,33} It is frequently impossible to determine grossly the exact nature of a tumor, whether it is benign or malign-

nant. Furthermore, an autopsy, no matter how carefully performed, will not disclose whether or not the subject has been relieved of a cancer months or years previously. Neither is the pathologist likely to make mention of numerous, small, discrete epitheliomas of the skin.¹⁸

It must be taken into account also that some malignant cells are capable of mutation and that, as a result of this quality, either the primary tumor or its metastasis may be mistaken for a second distinct primary cancer.

The inclusion of carcinosarcomatous neoplasms makes for an increase in the proportion of multiple malignancies, but it is considered proper to include multiple tumors of this nature in reports, carcinosarcomas of the thyroid gland excepted. Multiple primary sarcomas, comprising a small group, raise the incidence minimally.

The exclusion of cases from series either because they are not reported in sufficient detail or because they do not conform to arbitrary criteria, affects the incidence of multiple malignancies in a downward direction.

Finally, because of the increase in longevity and because of the concurrent rising incidence of cancer in general, there is conceivably the likelihood of a proportionate increase in the number of multiple cancers.

ACTUAL INCIDENCE

In view of the many factors involved, derivation of the actual incidence of multiple malignant neoplasms is most difficult. It is competent to presume however, that multiple cancers represent approximately 3.5 to 4 per cent of all malignancies, this being a higher proportion than usually reported but representing a figure deduced in reasonable agreement with the computations of others¹⁸ and in compatibility with personal experience.

AGE AND SEX INCIDENCE

It might be expected that the age and sex incidence of single cancers would not

vary greatly from the age and sex incidence of multiple cancers. In view of the preponderance of cancer of the skin in males, however, it is not surprising that a slight majority of male cases are reported in certain series. Furthermore, the frequency with which the male genitourinary apparatus is involved in multiple malignant neoplasia points to an apparent male predominance, but multiple cancers of the female genitalia, uterus and breast are so common as to balance this ostensible male prevalence.

In 476 cases of multiple cancers on which there was available information as to age and sex, Warren and Gates⁴⁵ found females to preponderate, 262 as against 214 males. The average age incidence for males was 58.3 years, for females it was 53.2 years. The average age incidence for the entire group was found to be 55.5 years.

The average age incidence for single cancers in males is 59 years, for females 57 years, and the average for both sexes is 58 years.

It thus appears that multiple primary cancers affect the sexes almost equally and at about the same age as do single cancers.

CAUSES OF MULTIPLE CANCERS

Despite the advancement of many ingenious and labored theories in explanation of the genesis of tumors, it must be admitted that few subjects are capable of arousing more interest or more controversy. Rather generally accepted, however, is the belief that tumors, particularly those of malignant nature, arise as the result of the interaction of two forces, an extrinsic factor adequate to incite cytogenesis and an intrinsic factor of susceptibility.

The late Willy Meyer estimated that 20 per cent of civilized human beings are predisposed to or exhibit an intrinsic susceptibility to cancer. Investigators have carried on extensive breeding experiments in order to determine the part played by hereditary factors.

In 1913, Maude Slye³⁸ discovered an hereditary relationship to spontaneous

malignancy in mice. Since then she has isolated strains of these animals that, regardless of environmental influence, have never developed a cancer. She has evolved other strains, however, which show a 100 per cent incidence of malignancy. Furthermore, she³⁹ has produced certain strains which show a tendency to develop special types of tumors, and still others that show a 100 per cent organ selectivity or susceptibility.

Maude Slye¹¹ contends that malignancy is transmitted as a localized recessive character and that for each type of cancer there is a unit recessive character capable of suppression by a dominant factor. She further believes that there is one unit recessive character for cancer and a similar unit recessive character which determines the site of neoplastic localization, where malignancy shall occur, both of which are suppressable by dominant characters. Accordingly, the genetic requirement for a malignant neoplasm in mice is two unit recessive characters, one for the malignancy itself and one for its localization; and the tendency to malignancy differs from the tendency to non-malignancy in only one gene.

According to the investigations of Maude Slye,^{39, 40} susceptibility and nonsusceptibility to spontaneous neoplasms in mice depend absolutely upon genetic factors.

Little²⁴ is convinced that the matter of inheritance is more complex than indicated in the cited conclusions of Slye. Certain inheritance factors are traceable to the cytoplasm and in some cases it is believed that the tendency to cancer inheritability is transmitted through dominant rather than recessive unit characters.

While these deductions are made from investigations on laboratory animals entirely, who can deny that man and mouse are governed by the same biological laws? It may be that susceptibility and nonsusceptibility to cancer depend in both upon like factors. At the Atlantic City meeting of the American Society for Cancer Research, Doctor Madge Thurlow Macklin, of the University of Western

Ontario, cited human family records showing what she believes is evidence for the inheritance of cancer tendency.

Many authors have expended profound efforts to explain the causes of multiple cancers in man. Hauser¹⁷ is of the opinion that they arise from multiple tumor anlage in the presence of a multiplicity of stimuli. Wooley⁴⁶ expressed the thought that whether the active proliferation is initiated by one or another factor, this would seem evident, that the factor to be effective the cells must be in a special state, so that whatever acts upon one organ, may affect similarly its pair. Seecof³⁷ was inclined to corroborate Ewing's⁶ opinion that the rather common occurrence of two or more tumors in different or the same organs of the same subject suggests nothing more than an accidental coincidence in several organs of the general biological factors in the genesis of tumors. Fried⁸ and Orr²⁹ assumed that a state of immunity is conferred by a first malignant tumor that prevents the appearance of a second cancer. The latter impression is known to be fallacious. There is no immunity to cancer. Hanlon¹⁶ suggested that multiple cancers develop incidentally and not in response to any law of neoplasia. Warren and Gates⁴⁵ conclude that multiple primary malignancies may be explained by a predisposition or susceptibility to carcinoma in certain persons or the action of some factor favoring the development of a malignant condition, the nature of which is unknown. This point of view coincides with that of Hartmann.¹⁵ Bugher³ states that there is an inherent susceptibility to cancer not possessed by all people. Broders¹⁸ found an hereditary factor present in 28.6 per cent of case histories in a series all the histories of which did not contain pertinent data. Burke,⁴ on similarly incomplete information, found evidence of the presence of an hereditary factor in 30.4 per cent of cases and pointed out that "the real importance of a higher incidence than can be explained on the basis of chance alone lies in its implication of the factors of heredity

(susceptibility) and environment (irritation, injury) in cancer etiology."

From the foregoing conclusions it is clearly evident that the consensus of opinion concerning the genesis of multiple cancers revolves about hereditary and environmental factors. It would appear that even though the unit character necessary for cancer susceptibility is present from birth, and persists throughout life, it may remain inactive in the absence of adequate environmental influences.

AUTHOR'S HYPOTHESIS

Genes present from birth need not become functionally operative for a prolonged interval. All genes do not reach functional maturity at identical periods of animal existence. Their influence, although specific, may indeed be complex. Some act singly, others multiply. Single genes are capable of producing manifold effects and, conversely, a number may be required to bring about a single result. Of greatest significance in the attempt to elucidate the etiological elements of multiple primary cancers is the knowledge that a gene is capable of producing a summation of effects upon various structures: the eye, skin, gastrointestinal and genitourinary organs.

Theoretically, the inference being drawn from cited animal experimentation, the origin of multiple malignant tumors can be explained by the interaction of a functionally mature gene bearing the unit character for cancer inheritance with a functionally mature gene having the unit character for cancer localization but endowed with the ability to effect various structures similarly. This interaction must of necessity take place in the presence of adequate environmental stimuli if multiple cancers are to be the result and the type of neoplasia will depend upon the histology of the structures acted upon by the unit character for localization. The sequence of tumor development, synchronously or metachronously, will depend upon local environmental forces, the presence or absence of persistent irritation. Tumors that develop

synchronously, however, may become manifest metachronously.

A gene is functionally mature when it is competent to produce its specific simple or compound effects, regardless of the individual's age. Even though most cancers develop in and beyond the fourth decade of life, it is the writer's opinion that the inheritance factors together with environmental influences are of greater significance than chronological age and that only those who inherit both unit characters, one for the malignant tumor and one for its localization, develop cancer when provoked by stimuli adequate to produce cytogenesis. Some of the known stimuli capable of producing cytogenesis are dibenzanthracene, cholanthrine, and aniline dyes, arsenic, radium, x-rays, chronically irritative and infectious processes and the rays of the sun.

Susceptible tissues undergoing biological changes such as embryological development or recovery from destructive injuries may be more quickly converted into malignant newgrowths by chemical physical, thermal and bacterial irritation because the process of reproduction, plasis of cellular elements, is already initiated. This may explain the origin of malignant tumors in the newborn or developing child as well as the appearance of similar tumors arising in chronically irritated sites of tissue injury. In any case, however, the requisite intrinsic factor of cancer susceptibility and localization must interact with environmental or secondary extrinsic factors if cancer is to appear.

CRITERIA

In consequence of advancing knowledge, it is generally agreed that the postulates of Billroth are too strict criteria for the accurate diagnosis of multiple primary cancers. Hanlon¹⁶ showed them to be impossible of fulfillment in a large percentage of malignant neoplasms and, although he adopted the postulates of Goetze, there exists an opinion^{4,45} that they, too, are of

limited applicability and should, therefore, be modified.

The solution to the problem of multiple

malignancies of different organs; and Group 3, three or more malignant tumors of the same or different organs.



FIG. 1. Case 1. Showing primary tumors of face and breast.

primary cancer differentiation may be resolved into an understanding of the following terse statement:

Each tumor must be a definite, distinct, atypical invasive newgrowth presenting the characteristic macroscopic and microscopic morphological features of an independent cancer, the cells of which are capable of equally characteristic metastasis.

CLASSIFICATION

Various opinions have been expressed in regard to the classification of these interesting tumors. Probably the simplest division was made by Kretschmer and Heckel.²² A change is made in the order of the latters' grouping so as to permit a closer correspondence between the sequence of groups and the reported frequency of incidence: Group 1, double malignancies of the same or symmetrical organs; Group 2, double



FIG. 2. Case 1. Appearance after treatment, May 15, 1937.

FREQUENCY OF VARIOUS COMBINATIONS

The skin is the most common site of multiple cancer localization. Approximately 30 per cent of double cancers are found in the gastrointestinal tract. Twenty-five per cent of multiple malignant tumors are distributed simultaneously in the gastrointestinal and genitourinary tracts. Ten per cent appear in the female breast and genitourinary tract concurrently and a similar number involve the female breast and the gastrointestinal tract coincidentally. Less than 4 per cent involve combinations of organs such as the skin and gastrointestinal tract and the skin and genitourinary tract. Lesser percentages comprise rarer combinations of structural involvement.

Although four cases of multiple primary cancers of the skin and five cases in which both ovaries were carcinomatous have been observed by the author, these are not considered worthy of detailed report because of the frequency with which skin cases

appear in the literature and because of the absence of substantial proof of primary multiplicity in the ovarian cases.



FIG. 3. Case 1. Photomicrograph of squamous cell carcinoma of face. $\times 100$.

The combined malignant involvement of the skin and the female breast is reported nine times in the literature. In five of these case reports the skin of the face was the locus of malignancy and in only one instance is it possible, although not specified, that the site was identical with that of the case here reported.

In eleven instances the thyroid gland is indicated as one of the sites of multiple primary malignancy. The literature reveals, however, that in none of these was the thyroid gland involved in combination with carcinoma of the lip. Because of the rarity of cancers involving simultaneously the female breast and the skin of the face, and because of the similar rarity of cancers concurrently present in the thyroid gland and the lip, the following cases are deemed worthy of detailed report.

CASE REPORTS

CASE 1. K. McD., a white female, aged seventy-seven, was referred to the St. Mary's Hospital Tumor Clinic February 12, 1937, by

Doctor J. J. G. The initial complaint was of "a bleeding lump on the face."

The family history was irrelevant except

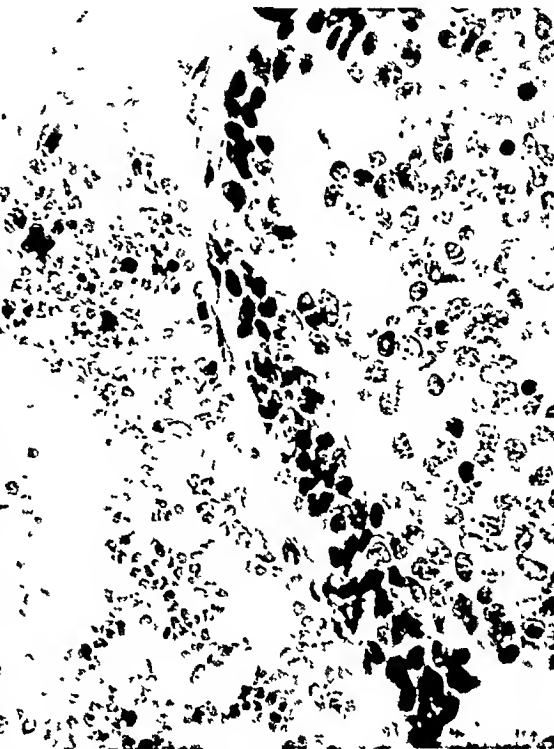


FIG. 4. Case 1. Photomicrograph of adenocystic carcinoma of breast. $\times 500$.

for the fact that one brother died at the age seventy-five of cancer of the bowel. The past history was negative.

The present condition began two years previously at which time a scale-like wart appeared in the middle of the right cheek. On November 20, 1936, an ulcer appeared in the center of the scaled area. The latter did not heal, and in December, 1936, the patient consulted her physician who made a biopsy study. Since December growth has been very rapid. Also, about two years previous to admission the patient fell and injured her right breast thus "rupturing a vein." A bloody discharge from the injured breast has recurred periodically in sufficient quantity to soil undergarments. The breast has slowly increased in size, but has not been painful.

Examination revealed a white, senile female with absence of subcutaneous fat and severe wasting. The skin over both cheeks was marked by small prominent capillaries. There was otherwise facial pallor except for areas on the both lower and upper eyelids and over the malar prominences which areas bore multiple, small, brown keratoses. Occupying the lower half of the left cheek and extending from just in

front of the lobe of the left ear to the lateral border of the corresponding malar prominence, and from 2 cm. below the zygoma, from above



FIG. 5. Case 11. Showing primary tumors of lip and thyroid gland.

downward over the mandible and into the carotid and submaxillary triangles of the neck, was a firm, granular, irregular sloughing tumor. (Fig. 1.) This tumor mass bled when manipulated however gently; it discharged a foul, seropurulent exudate and was fixed to the surrounding skin and underlying structures. It projected 6.5 cm. above the skin surface. There were no palpable glands in the neck.

The left breast was small and atrophic. The right breast was distorted by a tense, irregular mass that projected anteriorly and into the right anterior axillary line. The overlying skin was fixed to the tumor and the nipple was displaced upward and outward as well as retracted. The underlying structures were minimally fixed to the growth and gentle pressure did not induce a discharge from the nipple. The supraclavicular, infraclavicular and axillary regions were free of palpable lymphnodes. (Fig. 1.)

The remaining findings, including the blood Wassermann test, were negative except for evidence of chronic, hypertrophic arthritis in both knees and a mild secondary anemia.

Both the lesion on the left side of the face and in the right breast were clinically diagnosed as malignant. The former was thought to be a squamous cell carcinoma and the latter a papillary cyst carcinoma.

On February 15, 1937, a section was removed, without anesthesia, from the facial lesion for biopsy purposes and the patient was referred to Dr. B. H. J. for local roentgenotherapy immediately after operation.

May 3, 1937, the right breast was broadly removed, under novacaine anesthesia, through a Stewart incision, together with the underlying pectoralis major and minor muscles and their respective fascias. The wound of the latter operation healed by primary intention. Neither pre- nor postoperative roentgenotherapy was applied to the breast region. The patient was discharged from the hospital, greatly benefitted, May 15, 1937. (Fig. 2.) She continued under observation at the tumor clinic.

A report on the morbid anatomy of the removed tissues follows:

"Section from the face consists of a piece of friable, grayish white tissue 2.5 by 1.5 cm. On section the tissue cuts with a grating sensation and it grossly appears to be malignant.

"Microscopically there is a marked hyperplasia and hypertrophy of the epithelial layer with projections of epithelial cells into the underlying subcutaneous tissues. There are numerous mitotic figures seen and there is marked round cell infiltration. (Fig. 3.)

"Diagnosis: Squamous cell carcinoma.

"Breast specimen includes the entire breast, skin including area surrounding breast, and underlying muscles. Section through the breast shows a large cystic mass containing connective tissue septa. The wall of the cyst bears a rough surface with papillary-like, arborescent projections. Gross examination is quite typical of a malignant cyst, the contents being hemorrhagic.

"Microscopic section shows large nests of epithelial cells occasionally arranged in a somewhat adenomatous pattern. Surrounding these nests of malignant cells are large blood sinuses. There is very little reticulum. (Fig. 4.)

"Diagnosis: Duct type, adenocystic, carcinoma undergoing hemorrhagic degeneration."

Unto date there is no evidence of recurrence of the breast tumor. The facial lesion has completely healed, but there is a metastatic node in the right carotid triangle of the neck just below and posterior to the angle of the mandible. This latter lesion is being treated by Dr. B. H. J. with roentgenotherapy.

CASE 11. C. C., a white male, aged sixty-four, was referred to the St. Mary's Hospital Tumor Clinic by Dr. J. J. B. on October 9,

1938. The complaints were of an enlargement of the neck and a sore on the lower lip.

The family history was unknown, relatives

(Fig. 5.) The overlying skin was moveable within limits in all directions. A nodule, corresponding to the right lobe of the thyroid gland



FIG. 6. Case 11. Photomicrograph of squamous cell carcinoma of lip. $\times 100$.

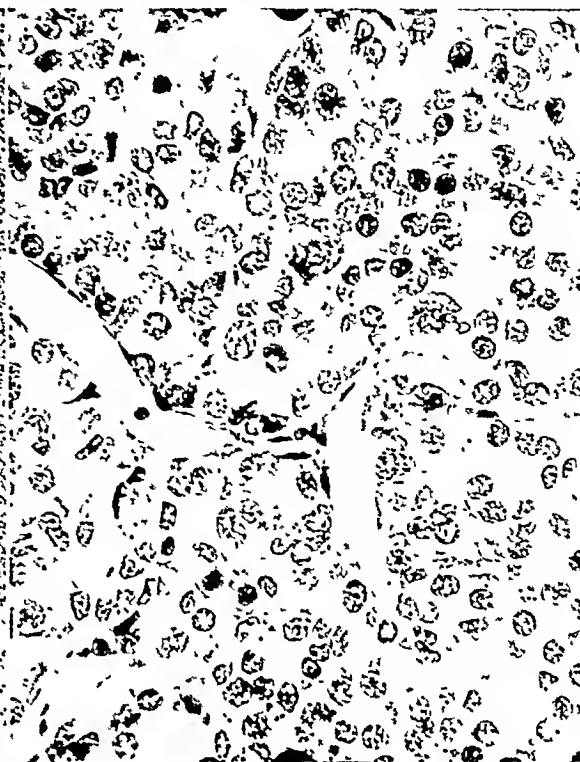


FIG. 7. Case 11. Photomicrograph of adenocarcinoma of thyroid gland. $\times 500$.

being in Poland. The past history was irrelevant. Alcohol was used sparingly and cigarettes likewise sparingly. The patient had lost indefinite small amount of weight in the past six months.

Physical examination revealed a white, partially stooped male approximately sixty years old. The color was good, the skin dry and soft, panniculus adiposa minimal. Station was well maintained. The organs of the head were essentially normal except for the lower lip (Fig. 5) in which there was a deep ulcer measuring 3 cm. in length and 1.5 cm. in width and which occupies principally the central portion of the vermillion surface. The floor of the ulcer was granular and necrotic. Its borders were irregular, edematous and indurated. There was no leukoplakia.

The upper and lower teeth were worn to about two-thirds their normal length. Several upper and lower molars were absent. The gums were edematous and discharged a purulent exudate.

The anterior two-thirds of the neck was occupied by a diffuse, generally smooth, somewhat fixed, irregular, firm but not hard swelling characteristic of thyroid gland enlargement.

faded diffusely into the larger mass. The circumference of the neck at its largest site, junction of lower and middle thirds, measured 43 cm. The supraclavicular space on the left was obliterated and the lower limits of the enlargement extended behind the clavicles and deeply into the suprasternal fossa. Upon swallowing there was an anterior propulsion rather than a rise of the tumor.

There was a smooth, soft freely moveable lymphnode which measured 2 by 1.5 cm. in the middle of the right posterior cervical triangle.

Kyphosis of the dorsolumbar spine and chronic hypertrophic arthritis of the joints of both hands were observed.

Roentgenray studies of the chest revealed a deviation of the trachea to the left and a grade 3 silicosis.

The pulse was regular, full, of normal tension and varied in rate between 80 and 86 per minute. The blood pressure was 140/80. The basal metabolic rate was plus 15. There were no tremors of the extended digits. The blood Wassermann test and the urine reports were negative.

On October 17, 1938, under novocaine anesthesia, the lymph node in the right posterior

triangle was completely enucleated and a section was removed from the lip for biopsy purposes.



FIG. 8. Case 11. Appearance after treatment, January 26, 1939.

An attempt was made to remove the thyroid tumor surgically, under gas-oxygen-ether anesthesia on October 25, 1938, but difficulties were encountered and the procedure was abandoned.

Sections from the lip (Fig. 6), "show a marked hyperplasia and hypertrophy of the epithelial layer with finger-like processes extending into the underlying tissues. The basement membrane at the tip of these processes is disrupted. There is marked round cell infiltration.

"Diagnosis: Squamous cell epithelioma."

Sections from the lymphnode (Fig. 7) "show a soft, yellowish, friable substance grossly suggestive of tuberculous adenitis. Microscopically there appear typical cells of thyroid gland acini in irregular arrangement. Occasionally an acinus is found containing colloid. The lymphnode is completely invaded with epithelial cells.

"Diagnosis: Metastatic adenocarcinoma from thyroid gland."

Roentgenotherapy was applied to the lip and thyroid tumors by Dr. B. H. J. during and subsequent to the patient's discharge from the hospital on November 16, 1938. When last examined at the Tumor Clinic, January 26, 1939, there was complete healing of the lip lesion and the thyroid tumor had resolved to a degree in which it was not palpable. (Fig. 8.) There was no evidence of regional or distant metastasis; there was a gain in weight and strength, and the only complaint was of a

slight residual hoarseness. This patient continues under observation at the Tumor Clinic.

SUMMARY AND CONCLUSIONS

1. The incidence of multiple primary cancers is between 3.5 and 4.0 per cent of all malignant lesions.

2. The genesis of multiple cancers is explained on the basis of the interaction of a functionally mature gene bearing the unit character for cancer inheritance with a functionally mature gene bearing the unit character for localization but endowed with the faculty to affect various structures similarly. This interaction must of necessity take place in the presence of environmental stimuli adequate for the production of cytogenesis. The type of neoplasia is dependent upon the structures affected by the unit character for localization.

3. The sequence of tumor development, synchronously or metachronously, depends upon local environmental forces, persistent irritation.

4. The criteria of multiple cancers is simplified as follows: Each tumor must be a definite, distinct, atypical, invasive new growth presenting the characteristic macroscopic and microscopic morphological features of an independent cancer, the cells of which are capable of equally characteristic metastasis.

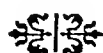
5. The classification of multiple cancers is revised as follows: Group 1, double malignancies of the same or symmetrical organs, Group 2, double malignancies of different organs; Group 3, three or more malignant tumors of the same or different organs.

6. Although a number of bizarre combinations of multiple primary tumors have been reported in the literature, certain rare combinations such as found in the present case reports are worthy of publication.

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OVARIAN HEMORRHAGE*

AN ANALYSIS OF TWENTY-EIGHT CASES FROM THE RECORDS OF THE JEFFERSON MEDICAL COLLEGE HOSPITAL, 1930 TO 1939 INCLUSIVE

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THE purpose of this paper is to report twenty-eight cases of ovarian hemorrhage and to suggest a new clinical term.

Ovarian hemorrhages, previous to 1900, were not clearly differentiated from those resulting from extra-uterine pregnancy,¹ although in 1845 Scanzoni reported a case of fatal hemorrhage from the ovary at menstruation in a girl eighteen years old. This clinical entity was referred to by earlier writers as apoplexy of the ovary.² Subsequent reports refer to hemorrhage from the ovary by lengthy and descriptive titles, as follows; intraperitoneal or abdominal hemorrhage of ovarian origin,^{3,4} ovarian rupture causing intraperitoneal hemorrhage,⁶ acute hemorrhage from corpus luteum and Graafian follicle,⁷ hemoperitoneum from ruptured corpus luteum,²⁰ perforative ovarian hemorrhage and the nonperforative type,³ ovarian hemorrhage,⁵ etc.

The authors are of the opinion that these headings, which have reference to a single clinical entity, may be gathered under one word, oophorrhagia.

The term, oophorrhagia, is proposed because it seems advisable to use a specific name, not only for the purpose of indexing these cases, but also to emphasize such an important and easily misinterpreted clinical condition. Parenthetically, the cases found by us and others in reviewing the clinical material available are relatively few, not because they are uncommon but because of the many diagnoses under which these cases are classified. The word oophor-

rhagia is derived from the Greek—*ὄον*—egg,—*φέρειν*—to bear, and—*ρήγνυναι*—to burst out, a bursting out from the ovary. The ending, “rrhagia,” by common usage denotes hemorrhage from the prefixed organ, of which there are many examples.

Oophorrhagia is that condition in which there is bleeding from an ovulatory site. The authors wish to confine the term to hemorrhage from an ovulatory site severe enough to cause clinical symptoms or signs. The amount of the hemorrhage varies from slight to profuse and from an intra-ovarian to the free peritoneal type. Various combinations of these types occur, but oophorrhagia, in its most characteristic form, is exemplified by the severe cases of bleeding into the peritoneal cavity. Clinically, the cases may be divided into two large groups: the severe types of abdominal hemorrhage and the discreet bleedings. The latter does not produce well defined diagnostic symptoms and signs. So true is this, that a very large percentage are never recognized. When the bleeding escapes freely into the abdominal cavity, the clinical picture is distinct.

The incidence of ovarian hemorrhage as stated by Simon⁴ varies from 0.33 per cent to 1.04 per cent of all gynecologic and surgical laporatomies. The number of such cases reported has grown rapidly. Reviewing the literature for instances of acute hemorrhage from the corpus luteum and Graafian follicle, Novak³ found forty cases in 1917. Johnson⁷ in another exhaustive search brought the total number to seventy-seven in 1930, while Israel,⁶ in his report

* Read before the Jefferson Society for Clinical Investigation, March 21, 1940.

of 1937, states that more than 300 cases had been recorded. There have been twenty-eight cases of oophorrhagia, as defined above by the writers, in a ten-year period, 1930 to 1939, taken from the records of the Jefferson Medical College Hospital. The authors do not believe, however, that an incidence of twenty-eight cases over a ten-year period represents the true occurrence of this condition. The use of a specific term under which to group this entity, and more meticulous attempts at diagnosis would undoubtedly reveal a greater number.

The etiology of clinically evident ovarian hemorrhage is a moot question. The number of different opinions expressed is an admission of lack of proven facts. The ordinary rupture of a Graafian follicle causes very little bleeding due to the relative avascularity of the stigma and the formation of a rounded clot in the follicular cavity.⁵ If conditions present in the abdomen cause hyperemia of the thecal vessels adjacent to the stigma or the clot fails to form, moderate to severe hemorrhage ensues. Ovarian bleeding may be due to bursting of varicose dilatations in the ovarian stroma when the follicle ruptures, as described by Schroder;¹ while Johnson⁷ believes that a premature separation of the ovum with hemorrhage, and premature rupture of the follicle, accompanied by the bleeding incident to the lacerations in the ovary, are the mechanisms producing the condition. On the other hand, rupture of the corpus luteum is an unnatural phenomenon. Hemorrhage, resulting from injury, or a solution of continuity of the thin-walled, vascular, bud-like projections in the lutein layer, during the formation of the corpus luteum, may be caused by sudden hyperemia of pelvic organs, an increase in intravascular pressure or increased intra-abdominal pressure.⁷ Other etiologic factors, quoted in the literature are, inflammatory ovarian congestion or sudden trauma,⁸ excessive menstrual hyperemia,⁹ chronic oophoritis,⁶ ordinary activities such as walking, dancing, wash-

ing clothes,^{3,20} during coitus,^{5,7} bimanual pelvic examinations,^{9,10,13} focal endarteritis¹¹ and a host of general diseases.⁹

A careful review of the twenty-eight records reported in this series fails to reveal any definite etiologic factor. Seven patients gave a history of constipation with purgation and enemas being employed when the ovarian hemorrhage occurred; only one instance of definite exertion is recorded. Although this finding fits in with quoted theories of increase in pelvic congestion or intra-abdominal pressure during ovulation, it is doubtful ground on which to base the cause of this clinical entity. Of more moment are the following facts: Eighteen or 64.2 per cent of the twenty-eight patients were nulliparous, the greater number were single women with fifteen or 53.5 per cent falling within the age group of

TABLE I

Age (Years)	No. of Cases
15-20	6
21-25	9
26-30	8
31-35	3
over	2

TABLE II

	Po	P1	P2	P+	?
Parity.....	18	0	3	0	7
No. of cases.....					

fifteen to twenty-five years. (Tables I and II.) The possibility of an endocrine imbalance seems to us more acceptable. Ovulation, with the nicely adjusted phases of folliculization, egg expulsion and formation of the corpus luteum, is possible only when a balance of the involved hormones exists. An imbalance of this intricate and delicate mechanism may cause abnormal or pathologic sequelae, one of which may be oophorrhagia.

The characteristic picture of a severe case of oophorrhagia is portrayed by the following history:

CASE 1. F. R. a white female aged twenty-nine years, single, entered the hospital with severe, sharp, continuous, left lower quadrant pain and prostration. She had been entirely well, except for a mild coryza, until twelve

hours previously, when she was seized with severe pain, low on the left side of the abdomen. Enema and citrate of magnesia had given no relief and with the continuance of the attack, the patient complained of drowsiness and thirst. There were no symptoms referable to the bowel or urinary tract and the last menstrual period had been normal.

On physical examination the abdomen was found slightly distended, with increased tension in the lower left quadrant and with general abdominal tenderness, particularly so in the left quadrant. Rebound tenderness was present but no definite evidence of fluid and no abnormal masses were palpable. The genitalia were negative and on rectal examination, no fullness or boggy mass of the peritoneum was demonstrable. Temperature was 99.6°F., pulse 100 and respiration 22. The red blood cell count was 3,250,000, hemoglobin 54 per cent and leucocytic count was 7,300. The urine was essentially negative. A preoperative diagnosis of hemorrhage from a corpus luteum was made.

Operation revealed free blood in the peritoneal cavity and old clots with a ruptured, left ovarian corpus luteum. The ovary was resected.

The above history is in contrast to the following, a mild case of ovarian hemorrhage:

CASE 11. D. T., a white female, aged twenty-five years and single, entered the hospital because of persistent, dull pain in the lower right quadrant and nausea, which came on suddenly about forty-eight hours previously. The patient stated that the pain was cramp-like and that by evening of the first day she became nauseated without vomiting. During a restless night, the nausea and pain continued but the latter was dull in character. The last two menstrual periods were uneventful and there was no constipation.

Physical examination was negative except for tenderness on firm pressure in the right lower quadrant with rebound tenderness. No rigidity was noted but more muscular spasm was present in the left lower quadrant. Pelvic examination was negative. Vaginal and cervical smears did not show intracellular diplococci. The urine was clear. The temperature was 99°F., pulse 100 and respirations 20. The red blood cell count was 4,350,000; hemoglobin 90 per cent, and white blood cell count 6,300.

The sedimentation rate was within normal limits. With a preoperative diagnosis of appendicitis the patient was operated upon.

At operation, a recently ruptured corpus luteum of the right ovary was found. The ovary was normal in size, with a circular opening on its surface of 3 or 4 mm. in diameter; this opening appeared to be plugged with a clear, jelly-like material. The appendix was removed. The final diagnosis was ruptured corpus luteum with slight hemorrhage.

One death occurred in this series. It was an unusual combination of acute appendicitis and ruptured corpus hemorrhagicum of the right ovary, with marked intra-abdominal bleeding, in a married white woman, forty-five years of age, who was admitted to the hospital in very poor condition several days after onset of symptoms.

In this series of twenty-eight patients all of whom were white, (McLaughlin²¹ found 96.5 per cent white patients in his series), eight were of sudden onset, thirteen complained of sharp abdominal pain, usually more intense and localized to the lower right quadrant, a few had peri- or subumbilical pain. Tenderness of the lower right quadrant was found in twenty-one, noted usually as below McBurney's point, and three in the lower left quadrant. Six patients had rebound tenderness in the quadrant involved, usually the right, while ten had slight unilateral rigidity of the rectus muscles. Nausea occurred in eleven patients, vomiting in four and, significantly, syncope in only three, while slight vaginal bleeding or "spotting" occurred twice. Fourteen of the patients had a pulse rate recorded between 90 and 109 per minute, and twenty-four temperature recordings were between 98 and 99.8 degrees F. The respiratory rate varied between 20 and 24 per minute in twenty-three. The blood pressure remained above 110 systolic in twenty-two patients and a leucocyte count ranging between 5,300 and 9,900 was found in sixteen patients. (Table III.)

From the above varied symptoms and signs, one can readily understand the large

percentage of inaccurate preoperative diagnoses reported in the literature. In this series, the preoperative diagnoses of appendicitis was made fifteen times, or 53.5 per cent, while ovarian hemorrhage was diagnosed correctly in only five instances, or 17.8 per cent. The following

TABLE III

	Signs	No. of Cases
T c m p.	98°-99.8°	24
	100°-100.8°	3
	101°-over	1
P u l s e	70-89 per min.	7
	90-109	14
	110-over	7
R e s p.	19-less per min.	1
	20-24	23
	25-over	4
W.	5,300-9,900	16
B.	10,000-15,000	5
C.	16,000-over	3

preoperative diagnoses were also made: "appendicitis or ovarian hemorrhage" twice, "ectopic or ovarian hemorrhage," "appendicitis or ectopic," "ectopic," "salpingitis," one of each and in two cases the preoperative diagnosis was not recorded. (Table iv.)

A correct preoperative diagnosis will depend on the following facts:

TABLE IV

Preoperative Diagnoses	No. of Cases
Acute appendicitis.....	4
Subacute appendicitis.....	6
Chronic appendicitis.....	5
Rupt. ovarian cyst.....	5
Ectopic.....	1
Salpingitis.....	1
Acute append.; ectopic.....	1
Rupt. ovarian cyst; ectopic.....	1
Rupt. ovarian cyst; chr. append.....	2
Unrecorded.....	2

1. To include oophorrhagia as a possibility, in the differential diagnosis of abdominal conditions in women.

2. To evaluate the symptomatology in the light of its relationship either to the time of ovulation or to the premenstruum.⁶ In our series, the condition occurred between the first and second weeks after a normal menstrual period in ten cases, after the third week in four cases, and only two cases occurred during the menses. (Table v.)

TABLE V

Relation to Menstruation	No. of Cases
First week postmenses.....	4
Second week postmenses.....	6
Third week postmenses.....	4
With menses.....	2
Unrecorded.....	12

3. To note that the normal or slight elevation of the temperature and leucocyte count are out of proportion to the severity of the pain.¹² With recession and gradual disappearance of the symptoms, as contrasted to the increasing severity of symptoms and signs in appendicitis.¹³

4. To note signs of internal bleeding with an absence of the signs of pregnancy.

5. To note that the cases lack a history of injury.¹⁴

The simultaneous occurrence of other pathologic states with oophorrhagia must be borne in mind. This possibility is well illustrated in the literature and in the series herein reported. Hematosalpinx,⁹ ectopic pregnancy³ and acute appendicitis¹² were found occurring simultaneously with ovarian hemorrhage at operation. Twenty-six of the twenty-eight patients were operated upon, showing at operation various degrees of ovarian bleeding. Three of these patients, in addition, revealed other pathology. One was complicated by chronic salpingitis, proven on microscopic examination and two cases were complicated by acute appendicitis, both grossly and on microscopic examination. One of the latter cases showed both salpinges markedly inflamed, though no pus could be expressed from the ostia. Of the twenty-six patients operated upon, though with sundry preoperative diagnoses, twenty-three were proven due to but one condition alone, that of primary ovarian hemorrhage.

The amount of blood found at operation varied from 2 to 3 ounces to an overflowing of the incision on opening the peritoneal cavity. Fourteen patients had free blood in the peritoneal cavity. Eight showed intra-ovarian hemorrhages and four were reported as ruptured corpus luteal or follicular cysts. The right ovary was involved in seventeen patients while the left was the

TABLE VI		No. of Cases
Ovary Involved and Type		
Right		17
Left		8
Bilateral		1
Corpus luteum (corp. hemorr.)		19
Graafian follicle		6
?	..	1

seat of the pathology eight times. (Table VI.) The corpus luteum was the cause of the hemorrhage in nineteen instances while the Graafian follicle was involved six times, with one in doubt. The operative procedure most commonly employed was oophorectomy. This was done in twelve cases. Unilateral salpingo-oophorectomy was resorted to in seven, and resection of the ovary in five instances. Needling of a small cyst in the opposite ovary was done in one patient. This is important when one recalls Ferguson's case.¹⁹ While performing a supravaginal hysterectomy, Ferguson noticed a large corpus luteum on the right ovary which he left intact. Twelve hours later, the same patient had symptoms and signs of abdominal hemorrhage; a second laparotomy revealed that the uncared for corpus luteum was found to have ruptured.

The prognosis in oophorrhagia is good. Hedde, quoted by Sackett,⁴ found only fifteen instances up to 1913 in which ovarian hemorrhage was dangerous to life. Johnson⁷ in his collective review of seventy-seven cases, in 1930, included six deaths, or 7.8 per cent. In our series there occurred one death due to hemorrhage, although the case was complicated by acute appendicitis, a mortality of 3.5 per cent.

As to the proper treatment to be followed in cases of oophorrhagia, the literature is more or less in agreement. In case of doubt, operate. Pratt,¹⁰ Brakely and

Farr¹² and Harris¹⁴ state that nonoperative treatment may be applicable in many instances, provided appendicitis and ectopic gestation are ruled out. In many cases operation could have been avoided, according to Meigs and Hoyt¹² because exploration showed that the bleeding had ceased or that it was simply physiologic. Stuekert⁵ Ravdin and Miller,¹⁶ on the other hand, declare that it is best to operate in all cases, even when the symptoms are mild, as a definite diagnosis cannot be made without laparotomy nor the possibility of continued bleeding be estimated. We are of the opinion that when in doubt the only procedure is laparotomy unless the diagnosis can be ruled out by doing a posterior colpotomy incision or the services of a trained peritoneoscopist are available. Conservatism must be practiced at operation, for many of the patients are in the prime of their reproductive period. This procedure is also advocated by McSweeney and Wood.²⁰

CONCLUSION

Oophorrhagia manifests itself by definite symptoms and signs in its severe forms, not unlike any other acute abdominal condition, with or without a definite expression of hemorrhage. Ovarian hemorrhage may assume a mild form, expressing itself in symptoms and signs of slight peritoneal irritation. In the former cases, the differential diagnosis from ectopic pregnancy and acute appendicitis is necessary in the latter form, the milder inflammatory diseases of the appendix or adnexa. It is obvious that the former two conditions, together with the severe ovarian type of bleeding, demand operative intervention but the second group of patients, including the milder forms of bleeding, demand careful study.

SUMMARY

1. A term is suggested to emphasize the clinical entity—ovarian hemorrhage. The term as defined is limited to hemorrhage

from an ovulatory site as exemplified by the cases herein studied.

2. All of the patients were white, in a hospital having approximately 50 per cent colored admissions. Sixty-four and two-tenth per cent of the patients were nulliparous, the greater number single women, 53.5 per cent falling within the age group of fifteen to twenty-five years.

3. Peritoneoscopy or posterior colpotomy is recommended in doubtful cases of lower abdominal pathology in women.

4. Conservatism is advocated in the cases brought to operation.

We wish to thank the members of the staff of Jefferson Hospital for the use of these case records. A tabulation of the services on which the cases reported occurred follows:

	No. of Cases
Shallow, Dr. Thomas A.....	9
Klopp, Dr. Edward.....	5
Bland, Dr. P. Brooke.....	2
Castallo, Dr. Mario A.....	2
Montgomery, Dr. John.....	2
Dugger, Dr. John.....	2
Bland, Dr. George.....	1
Muller, Dr. George.....	1
Stuckert, Dr. Harry.....	1

Spangler, Dr. Clyde.....	1
Surver, Dr. James.....	1
Wakling, Dr. Adolph.....	1
Total.....	28

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A STUDY OF THE IMMEDIATE POSTOPERATIVE COMPLICATIONS AND MORTALITY IN CERTAIN GENERAL SURGICAL OPERATIONS*

ANALYSIS OF 662 CASES AT THE PHILADELPHIA GENERAL HOSPITAL, 1936 TO 1939

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THIS study was undertaken to obtain facts concerning the immediate postoperative complications and mortality in the cases commonly coming to the general surgical department of a large charity hospital. Certain groups of operations were selected so as to give numbers sufficient for statistical analysis. The groups of operations considered in this study were appendix surgery, peptic ulcer surgery, hemorrhoid surgery, biliary tract surgery and hernia surgery. A total of 662 cases was studied. All of these cases were consecutive cases admitted to the Surgical Services of Dr. E. L. Eliason and Dr. L. K. Ferguson at the Philadelphia General Hospital between January 1, 1936 and July 1, 1939. This interval represents a time period of two and one-half years.

Complications were arbitrarily divided into five groups. The complications which occurred among the cases studied were as follows: 1. *Wound Complications*: Grades A, B, and C. 2. *Abdominal Complications*: Nausea and vomiting, postoperative distention, gastric dilatation, subdiaphragmatic abscess, pelvic abscess, peritonitis, fecal impaction. 3. *Pulmonary Complications*: Acute bronchitis, postoperative atelectasis, postoperative pneumonia, pulmonary infarct, pulmonary embolism. 4. *Upper Respiratory Complications*: Vincent's angina, acute follicular tonsillitis, upper respiratory infection. 5. *All Other Complications*: Liver shock, headache, decubitus ulcer, phlebitis,

bleeding (wound), conjunctivitis, parotitis, incontinence of urine and feces, cystitis, toxic delirium, icteric toxemia, polyneuritis.

RESULTS

The incidence and types of immediate postoperative complications and mortality in relation to the types of operations performed are summarized in Table 1. There were no deaths in those cases subjected to hemorrhoidectomy or herniorrhaphy. Of the former 3.28 per cent of the cases developed postoperative complications and of the latter 13.4 per cent developed postoperative complications. Of the patients subjected to appendectomy 1.3 per cent died and 20.8 per cent developed postoperative complications. Of those subjected to peptic ulcer surgery 19.6 per cent died and 39.2 per cent developed postoperative complications. Of those subjected to biliary tract surgery 11.1 per cent died and 39.5 per cent developed postoperative complications. The specific types of complications and causes of mortality will be taken up in the discussion of the operations themselves.

The incidence and types of immediate postoperative complications and mortality in relation to pathology of appendicitis existing at the time of operation are summarized in Table 11. The total number of cases of appendicitis studied was 240. The mortality rate for this group of cases was 1.25 per cent. Of the three patients who died all presented themselves at the hospi-

* From the General Surgical Services of Doctors E. L. Eliason and L. Kraeer Ferguson, The Philadelphia General Hospital, Philadelphia, Pennsylvania, 1940.

TABLE I

INCIDENCE AND TYPES OF IMMEDIATE POSTOPERATIVE COMPLICATIONS AND MORTALITY IN RELATION TO TYPES OF OPERATIONS. ANALYSIS OF 662 CASES PHILADELPHIA GENERAL HOSPITAL

	Total		Appendec- tomy		Peptic Ulcer Surgery		Hemor- rhoidec- tomy		Biliary Tract Surgery		Hernior- rhaply	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Total cases.....	662	.....	240	.....	46	.....	183	.....	81	.....	112	.....
Mortality.....	21	3.18	3	1.3	9	19.6	0	0	9	11.1	0	0
Total complications.....	121	18.25	50	20.8	18	39.2	6	3.28	32	39.5	15	13.4
Wound complications.....	21	3.18	11	4.6	1	2.2	1	0.55	2	2.47	6	5.36
Abdominal complications.....	39	5.9	23	9.6	4	8.7	2	1.09	9	11.1	1	0.89
Pulmonary complications.....	36	5.44	7	2.9	11	23.9	1	0.55	10	12.34	7	6.25
Upper respiratory complications.....	6	0.9	2	0.83	1	2.2	0	0	2	4.47	1	0.89
All other complications.....	19	2.87	7	2.9	1	2.2	2	1.09	9	11.1	0	0
Causes of Death												
Liver shock.....	5	0.75	...	.....	..	.....	...	.....	5	6.2	...	.....
Peritonitis.....	5	0.75	2	0.8	2	4.3	...	.....	1	1.2	...	.....
Subdiaphragmatic abscess.....	3	0.45	...	.....	2	4.3	...	.....	1	1.2	...	.....
Postoperative pneumonia.....	5	0.75	...	.....	4	8.7	...	.....	1	1.2	...	.....
Pulmonary embolus.....	1	0.15	...	.....	1	2.2	...	.....	...	...	...	.....
Postoperative parotitis.....	1	0.15	1	0.4	...	.....	...	.....	...	...	...	.....
Icteric toxemia.....	1	0.15	...	.....	..	.....	...	.....	1	1.2	...	.....

TABLE II

INCIDENCE AND TYPES OF IMMEDIATE POSTOPERATIVE COMPLICATIONS AND MORTALITY IN RELATION TO TYPES OF APPENDICITIS PRESENT AT OPERATION. ANALYSIS OF 240 CASES. 1936 TO 1939. PHILADELPHIA GENERAL HOSPITAL

	Acute Appen- dicitis		Acute Appen- dicitis with Per- foration, Gan- grene or Abscess		Chronic Recur- rent Appendi- citis		Total Cases Appendicitis	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Total cases.....	120	.....	68	.....	52	.....	240	.....
Mortality.....	0	0	3	4.4	0	0	3	1.25
Total complications.....	14	11.7	27	39.7	9	17.6	50	20.8
Wound complications.....	6	5.0	(3)	4.4	2	3.8	11	4.6
Abdominal complications.....	2	1.7	18	26.5	3	5.8	23	9.6
Pulmonary complications.....	3	2.5	1	1.5	3	5.8	7	2.9
Upper respiratory complications.....	1	0.8	0	0	1	1.9	2	0.8
All other complications.....	2	1.7	5	7.3	0	0	7	2.9
Causes of Death								
Peritonitis.....	...	.....	2	2.9	..	.....	2	0.8
Postoperative parotitis.....	...	.....	1	1.5	..	.....	1	0.4

tal with perforated appendices. Immediate postoperative complications developed in 20.8 per cent of the cases. Wound complica-

TABLE III
INCIDENCE AND TYPES OF IMMEDIATE POSTOPERATIVE COMPLICATIONS OCCURRING IN HEMORRHOIDECTOMIES. ANALYSIS OF 183 CASES

	Hemorrhoidectomies	
	No.	Per Cent
Total cases	183	
Mortality	0	0
Total complications	6	3.28
Wound complications	1	0.55
Abdominal complications	2	1.09
Pulmonary complications	1	0.55
Upper respiratory complications	0	0
All other complications	2	1.09

tions developed in 4.6 per cent of the cases, abdominal complications in 9.6 per cent of the cases, pulmonary complications in 2.9 per cent of the cases and upper respiratory complications in 0.8 per cent of the cases.

eral incidence of abdominal complications particularly ran high in the group of acute appendicitis with perforation, gangrene or abscess. The incidence of complications was 26.5 per cent and among these complications were nausea and vomiting, postoperative distention, peritonitis and pelvic abscess.

There were no deaths in the acute and chronic recurrent appendicitis groups. Three deaths occurred in the group of acute appendicitis with perforation, gangrene and abscess. Two deaths were due to postoperative peritonitis and one to postoperative parotitis.

The incidence and types of immediate postoperative complications in those cases having hemorrhoidectomy are summarized in Table III. There were 183 such cases. No deaths occurred in this group and only 3.28 per cent developed complications.

The incidence and types of immediate postoperative complications and mortality

TABLE IV
INCIDENCE AND TYPES OF IMMEDIATE POSTOPERATIVE COMPLICATIONS AND MORTALITY IN RELATION TO TYPES OF PEPTIC ULCER PATHOLOGY PRESENT AT TIME OF OPERATION. ANALYSIS OF 46 CASES. 1936 TO 1939. PHILADELPHIA GENERAL HOSPITAL

	Elective Peptic Ulcers		Hemorrhaging Peptic Ulcers		Perforated Peptic Ulcers		All Cases Peptic Ulcer	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Total cases	13		12		21		46	
Mortality	1	7.7	0	0	8	38.1	9	19.6
Total complications	5	38.5	3	25	10	47.6	18	39.2
Wound complications	1	7.7	0	0	0	0	1	2.18
Abdominal complications	0	0	0	0	4	19.2	4	8.7
Pulmonary complications	3	23.1	2	16.7	6	28.6	11	23.9
Upper respiratory complications	1	7.7	0	0	0	0	1	2.18
All other complications	0	0	1	8.4	0	0	1	2.18
Causes of Death								
Postoperative pneumonia	1	7.7			3	14.3	4	8.7
Pulmonary embolus					1	4.8	1	2.2
Peritonitis					2	9.5	2	4.3
Subdiaphragmatic abscess					2	9.5	2	4.3

In the group of acute appendicitis with perforation, gangrene, or abscess, only those wounds which were closed without drainage and later broke down were included as wound complications. The gen-

eral incidence of abdominal complications existing at time of operation are summarized in Table IV. There were forty-six cases in this group. The general mortality percentage in this group of cases was 19.6 and the inci-

dence of complications was 39.2 per cent. Wound complications occurred in 2.18 per cent of the cases, abdominal complications in 8.7 per cent of the cases, pulmonary complications in 23.9 per cent of the cases and upper respiratory complications in 2.18 per cent of the cases.

Abdominal complications were particularly high in the perforated peptic ulcer group (19.2 per cent). Pulmonary complications were high in all groups (23.9 per cent average), but were relatively low in the hemorrhaging peptic ulcer group.

The incidence and types of immediate postoperative complications occurring in those cases subjected to inguinal herniorrhaphy are summarized in Table v. There were 112 cases in this group. There were no deaths, but complications occurred in 13.4 per cent of the cases. Wound complications occurred in 5.35 per cent of the cases; abdominal complications occurred in 0.89 per cent of the cases; pulmonary complications in 6.25 per cent and upper respiratory complications in 0.89 per cent of the cases.

The incidence and types of immediate postoperative complications and mortality

in those cases subjected to biliary tract surgery are summarized in Table vi. Three were eighty-one cases in this group. Of all these patients 11.1 per cent died and 39.9

TABLE V
INCIDENCE AND TYPES OF IMMEDIATE POSTOPERATIVE COMPLICATIONS OCCURRING IN INGUINAL HERNI-
ORRHAPHIES. ANALYSIS OF 112 CASES

	Herniorrhaphies	
	No.	Per Cent
Number of cases.....	112	
Mortality.....	0	0
Total complications.....	15	13.4
Wound complications.....	6	5.35
Abdominal complications.....	1	0.89
Pulmonary complications.....	7	6.25
Upper respiratory complications.....	1	0.89
All other complications.....	0	0

per cent developed postoperative complications. Wound complications occurred in 2.47 per cent of the cases, abdominal complications in 11.1 per cent of the cases, pulmonary complications in 12.65 per cent

TABLE VI

INCIDENCE AND TYPES OF IMMEDIATE POSTOPERATIVE COMPLICATIONS AND MORTALITY IN RELATION TO TYPE OF OPERATIONS DONE ON THE BILIARY TRACT. ANALYSIS OF 81 CASES. 1936 TO 1939.
PHILADELPHIA GENERAL HOSPITAL

	Cholecystectomy		Cholecystostomy		Choledochostomy		All Others		Total	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Number of cases.....	45	.....	19	.....	14	.....	3	..	81	
Mortality.....	3	6.6	3	15.8	2	14.2	1	..	9	11.1
Total complications.....	19	42.2	7	38	4	28.6	2	..	32	39.5
Wound complications.....	1	2.22	0	0	1	7.15	0	..	2	2.47
Abdominal complications.....	8	17.8	1	5.27	0	0	0	..	9	11.1
Pulmonary complications.....	7	15.6	3	15.8	0	0	0	..	10	12.65
Upper respiratory complications.....	1	2.22	0	0	0	0	0	..	1	1.26
All other complications.....	2	4.44	3	15.8	3	21.4	2	..	10	12.65
Causes of Death										
Liver shock.....	1	2.22	2	10.5	1	7.15	1	..	5	6.16
Subdiaphragmatic abscess.....	1	2.22	0	0	0	0	0	..	1	1.26
Peritonitis.....	0	0	1	5.27	0	0	0	..	1	1.26
Postoperative pneumonia.....	1	2.22	0	0	0	0	0	..	1	1.26
Icteric toxemia.....	0	0	0	0	1	7.15	0	..	1	1.26

of the cases and upper respiratory complications occurred in 1.26 per cent of the cases. Of interest is the relatively high incidence of abdominal complications (17.8 per cent) and pulmonary complications (15.6 per cent) in the group subjected to cholecystectomy.

TABLE VII
INCIDENCE OF MORTALITY AND IMMEDIATE POSTOPERATIVE COMPLICATIONS IN RELATION TO ANESTHETIC AGENT. ANALYSIS OF 662 CASES. PHILADELPHIA GENERAL HOSPITAL, 1936 TO 1939

Anesthetic Agent	No of Cases	Mortality		Complications	
		No	Per Cent	No	Per Cent
Gas-ether	108	2	1.85	28	27
Cyclopropane-ether	55	0	0	9	16.4
Ether	15	0	0	6	40
Cyclopropane	26	4	15.4	10	38.4
Gas (N ₂ O)	1	0	0	1	100
Spinal novocaine	308	9	2.92	49	15.9
Spinal metycaine	11	0	0	1	9.1
Spinal pontocaine	6	0	0	0	0
Spinal nupercaine	6	0	0	1	16.7
Spinal novocaine-cyclopropane	—	0	0	0	0
Spinal pontocaine-cyclopropane	1	0	0	0	0
Spinal nupercaine-cyclopropane	1	0	0	0	0
Spinal novocaine-gas ether	4	0	0	1	25
Sacrocaudal block (novocaine)	8	0	0	0	0
Nerve block (novocaine)	2	0	0	0	0
Local novocaine	103	6	5.85	15	14.6
Total	662	21	3.18	121	18.25
All inhalation anesthetics	205	6	2.92	54	26.4
All spinal anesthetics	331	9	2.72	51	15.4
All local anesthetics	113	6	5.3	15	13.3
Combined	13	0	0	1	7.7

"Liver shock" accounting for the deaths of 6.16 per cent of the patients having a biliary operation appeared to be the most common cause of death in the cases subjected to surgery of the biliary tract.

The incidence of immediate postoperative complications and mortality in relation to the anesthetic agent use are summarized in Table VII. In considering the high mortality associated with cyclopropane (15.4 per cent) and local novocain (5.85 per cent) it should be mentioned that the poor risk patients received these anesthetics. The incidence of mortality in those patients receiving gas-ether and spinal novocain, the two most commonly used anesthetics, was very close, 1.85 per cent in the former and 2.92 per cent in the latter. There were

no actual anesthetic deaths in the series of 662 cases. The mortality was due in each case to the patient's disease and not the anesthetic agent.

The incidence of immediate postoperative complications was approximately two times as high in those patients receiving gas-ether as it was in those receiving spinal novocain.

The incidence and types of immediate postoperative complications and mortality in relation to the type of anesthesia used are summarized in Table VIII. Two hundred five patients received inhalation anesthetics and of this number 2.9 per cent died and 26.4 per cent developed postoperative complications. Three hundred thirty-one patients received spinal anesthetics and of this number 2.7 per cent died and 15.4 per cent developed postoperative complications. One hundred thirteen patients received local anesthetics and of this number 5.3 per cent died and 13.3 per cent developed complications.

It is interesting to note that the incidence of wound complications was approximately two times as high in those cases getting inhalation anesthesia as it was in those cases getting spinal or local anesthesia. Abdominal complications were about equally divided among those receiving inhalation anesthesia and those receiving spinal anesthesia. In those cases receiving inhalation anesthesia the incidence of respiratory complications was approximately three times as high as in those cases receiving spinal anesthesia. The respiratory complications occurring with inhalation anesthesia were acute bronchitis (four cases), postoperative atelectasis (ten cases), postoperative pneumonia (three cases), and pulmonary infarct (two cases). Two of the patients developing pneumonia eventually died. Respiratory complications occurring in those cases receiving spinal anesthesia were postoperative atelectasis (five cases), postoperative pneumonia (five cases), and pulmonary embolism (one case). Three of the patients developing pneumonia and the patient developing pulmonary embolism eventually died.

Analysis of the 662 cases in regard to immediate postoperative complications and mortality relative to age by decades was made. The incidence of complications remained practically constant through the decades to the seventh decade (60 to 69) in which there was somewhat of a rise in incidence. Abdominal complications appeared to be relatively higher in the first, fifth and seventh decades. The incidence

logical condition is far advanced. It is possible that these factors may play some part in the relatively high incidence of mortality and immediate postoperative complications in some of the more severe operations studied.

SUMMARY AND CONCLUSIONS

1. Certain facts concerning the immediate post-operative complications and

TABLE VIII

INCIDENCE OF MORTALITY AND IMMEDIATE POSTOPERATIVE COMPLICATIONS IN RELATION TO ANESTHESIA USED. ANALYSIS OF 662 CASES. 1936 TO 1939. PHILADELPHIA GENERAL HOSPITAL

	Inhalation		Spinal		Local		Combined Inhalation and Spinal		Total	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Total cases.....	205	.....	331	.....	113	.....	13	..	662	
Mortality.....	6	2.9	9	2.7	6	5.3	0	0	21	3.18
Total complications.....	54	26.4	51	15.4	15	13.3	1	..	121	18.25
Wound complications.....	10	4.88	7	2.12	3	2.66	1	..	21	3.17
Abdominal complications.....	14	6.86	21	6.35	4	3.54	0	..	39	5.9
Pulmonary complications.....	19	9.27	12	3.63	5	4.43	0	..	36	5.44
Upper respiratory complications.....	5	2.44	1	0.3	0	0	0	..	6	0.9
All other complications.....	6	2.83	10	3.02	3	2.66	0	..	19	2.86
Causes of Death										
Liver shock.....	1	0.5	1	0.3	3	2.7	..	..	5	0.75
Peritonitis.....	2	1	1	0.3	2	1.8	..	..	5	0.75
Subdiaphragmatic abscess.....	1	0.5	1	0.3	1	0.9	..	..	3	0.45
Postoperative pneumonia.....	2	1	3	1.5	...	.....	..	..	5	0.75
Pulmonary embolus.....	...	.....	1	0.3	...	.....	..	..	1	0.15
Postoperative parotitis.....	...	.....	1	0.3	...	.....	..	..	1	0.15
Icterus toxemia.....	...	.....	1	0.3	...	.....	..	..	1	0.15

of postoperative pulmonary complications and wound complications remained practically constant through the various decades. The incidence of mortality was increased in the fifth decade and above. In general we were unable to find any variation of significance in the types or incidence of complications in the various age groups.

REMARKS

In most cases the patients coming to this large charity hospital are poorly nourished and deficient in vitamins. They are usually below the average mentally and usually do not come to the hospital until their path-

mortality in 662 consecutive surgical cases coming to the Philadelphia General Hospital from January 1, 1936 to July 1, 1939 are presented.

2. The surgical procedures considered were appendix surgery (240 cases), peptic ulcer surgery (forty-six cases), hemorrhoid surgery (183 cases), biliary tract surgery (eighty-one cases), and inguinal hernia surgery (112 cases).

3. Of particular interest is the relatively high incidence of postoperative pulmonary complications in the patients receiving inhalation anesthesia as compared to those receiving spinal anesthesia.

THE ANATOMY OF THE SPHINCTER OF ODDI*

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THE structure of the musculature surrounding the intramural portion of the common bile duct has been studied extensively by various methods. Reconstructions have not been attempted because of the complex structure of the adult muscle pattern. It was believed, therefore, that even if the result of such an attempt were not entirely accurate, it might prove to be valuable for demonstration purposes. The reconstruction model is here presented and discussed.

LITERATURE

The earliest mention of the anatomical relationship of the choledochoduodenal juncture is credited to Vesalius.¹ In 1543, discussing the ideas prevalent at the time, he stated that by dissection it was learned that "not the smallest part of the bile vesicle was extended into the stomach." He also described the valvular nature of the longitudinal folds preventing regurgitation into the biliary tract.

Fallopian,² in 1561, emphasized the oblique course of the duct through the intestinal wall, but Glisson,³ in 1654, was the first to suggest the existence of a sphincteric mechanism at the lower end of the common duct. He believed that the sphincter existed only to prevent regurgitation of chyme and that the regulation of the flow of bile into the intestine was accomplished by a separate sphincter around the neck of the gallbladder. Bianchus⁴ about 1711 in his book "Historia Hepatica" first postulated the idea that the sphincter at the outlet of the common duct was concerned with the flow of bile.

Following this observation there seems to have been little done until Luschka,⁵ in 1869, studying the pars intestinalis of the

common bile duct in man, found no separate smooth muscle fibers around the common duct. In 1879, Gage⁶ described the existence of a sphincter in the cat.

Then in 1887, Oddi⁷ investigated the intramural portion of the common bile duct in animals by histological means. He described "a more or less pronounced bed of circular fibers encircling the choledochal canal, which one is able to consider as almost completely independent, if one excepts some slender loops which lose themselves between the fibers proper of the intestine."

Znaniacki,⁸ in 1895, studied cross sections of the choledochoduodenal juncture and described a definite arrangement of smooth muscle fibers separate from the muscularis mucosae and the other duodenal musculature.

Hendrickson,¹⁰ in 1898, reported gross and microscopic studies of the extrahepatic biliary system of the dog, rabbit and man. He concluded that transverse, longitudinal and diagonal muscle fibers can be found in all parts of the biliary system in each species and that a definite sphincter of Oddi exists in all three.

Letulle and Nattan-Larrier¹¹ and Helly¹² further described the anatomical arrangement of muscle bundles.

Stoianoff¹³ investigated the biliary passages in the dog and concluded there was no true sphincter at the terminal end of the ductus choledochus, unless the fibers of the circular muscle layer of the duodenum were regarded as such.

Various investigators (Stracker,¹⁴ Broman,¹⁵ Rost,¹⁶ Mann,¹⁷ Auster and Crohn,¹⁸ Matsuno,¹⁹ Westphal,²⁰ Nagai and Sawada,²¹ Burget,^{22,23} Job²⁴) have studied the musculature of the choledochoduodenal

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juncture in many types of animals and man. The descriptions even in the same animals vary, although all agree as to the presence of muscle bundles capable of sphincteric activity.

In the guinea pig and opossum the ampulla is distinct from the duodenal wall and has its own smooth musculature.^{25, 26, 27} This suggests that perhaps the relationship between these muscle fibers may be only a phylogenetic stage resulting in higher animals in a blending of the two groups to such an extent as to make separate identification questionable.

Giordano and Mann,²⁸ in 1927, reviewed these findings and reported further studies on the intramural portion of the common duct in more than twenty species of animals. They concluded that while variations in species and individuals of the same species occur frequently, "it is usually possible to find a definite bundle of smooth muscle surrounding the common bile duct, contractions of which would tend to close the lumen."

Nuboer³² and Porsio²⁹ both described muscle arrangements in man which derived from the circular muscle of the duodenum, but which were so arranged as to act as a sphincter.

Schwegler and Boyden³⁰ again investigated the anatomy of this region by studying the appearance and development of the smooth muscle fibers in successive embryonic stages. They concluded "that all constituents of the sphincter of Oddi (except, perhaps, the X fibers of Hendrickson) are of mesenchymal origin, that is, they develop as a true *musculus proprius* of the ducts."

Kreilkamp and Boyden³⁵ dissected twelve adult specimens of the choledocho-duodenal juncture by a new maceration technic. They found a well developed sphincter pancreaticus in only four and a sphincter ampullae in only two of the group. They suggested that anatomical variations are important factors in the pathological physiology of the biliary tract.

A historical summary of the many

anatomical investigations on this important region will allow one general conclusion. The greater weight of evidence supports the existence of variable amounts of smooth muscle tissue in animals and man which, regardless of origin, may possess sphincteric activity at the outlet of the common bile duct.

METHOD

Heretofore, three methods have been employed to study the musculature of this region. The study of serial sections was done first by Gage in 1879. Oddi also used this method, as did many others. There are several objections to this method. Even when specific smooth muscle stains are used, individual interpretations vary. Furthermore, gradations in structure are visualized only with difficulty. A second method is the use of maceration preparations. This procedure was first employed by Oddi⁷ and then by Hendrickson¹⁰ (1898). This method destroys part of the structure so that comparisons are again relatively inaccurate. Recently, however, Kreilkamp and Boyden³⁵ have described a perfected maceration technic consisting in alternately hardening and softening the specimen during dissection, which seems to obviate some of the objections to the older method. Schwegler and Boyden³¹ studied serially sectioned embryos of various ages and reconstructed the developing musculature before it became complex. Three dimensional reconstructions have not been attempted because of the complexity of the muscle pattern. However, despite the obvious technical problems involved, an attempt has been made to reconstruct the smooth muscle surrounding the choledocho-duodenal juncture in man.

The specimen from which the reconstruction was made was obtained at necropsy from an adult male who died of disease unrelated to the biliary system. At the necropsy table a piece of small caliber glass tubing was inserted through the ampulla so as to maintain the architectural relationships during the fixation process. The

specimen was trimmed down so that the final length was about 1 cm. After the tissue had been hardened in formalin and prepared for embedding in paraffin, the glass tubing was replaced by a similar tube of paraffin. The presence of the tube compressed the mucosal villi together to a small extent, but a study of the completed sections showed the distortion of the muscle bundles to be negligible. After embedding in paraffin, serial sections were cut and stained according to Van Gieson's method. In the usual type of reconstruction work it is customary to use each or every other section. It was readily apparent in the present work that if this were done and sections 1 mm. thick were used, the resulting model of a sufficient length of the choledochoduodenal juncture to demonstrate relationships would result in a reconstruction more than 2 feet in length. Accordingly, each section was cut 10 micra thick and every fifth section used. In this way a sufficient amount of muscle tissue was visualized to allow adequate study of its relationship. The sections were then studied microscopically and camera lucida drawings of the smooth muscle bundles made, using the lumen of the common bile as a center "core." The complexity of the muscle pattern was such that strict reproduction of all the minute variations in structure from slide to slide was not practicable. The pictures obtained were already so intricate that no attempt was made to separate longitudinal from circular muscle fibers. Because of this, certain arrangements of these two muscle layers which have been shown to exist cannot be demonstrated in the model.

The musculature was then reconstructed in wax, using the Born method. It was found that the wax model not only sagged where the structure thinned out, but narrow corners and edges chipped off. In addition, the model was too fragile to handle easily, so demonstration of any but the outside surfaces could not be carried out. The possibility of casting the model out of some more durable material was con-

sidered and several experts in industrial casting and die-making were consulted. None of them would promise any result and the process of casting the structure would destroy the original model. Then an attempt was made to coat the outer side of the model with some metal; a rough sample model of similar shape and material was coated with graphite and sprayed with aluminum paint. The result was not successful. As a final alternative the reconstruction process was repeated, using a pliable aluminum sheeting instead of wax plates. Aluminum was chosen because of its light weight and its relatively low cost. The resulting model is durable, may be handled with relative ease and will never change shape or become brittle as with wax models. When finished, the model was bisected with a band saw. The muscle component was painted red and the center core, representing the lumen of the common duct, painted black. The transverse magnification as computed by stage scale comparison and measurement is 75, and the vertical magnification due to the use of every fifth section is 20.

OBSERVATIONS

In the following description the term "distal" refers to the intestinal end of the common bile duct, and "proximal" to the portion of the common duct extending up to the liver.

The Choledochal Window. The base of the model represents the portion of the musculus proprius of the common bile duct at the hiatus through the muscle coats of the duodenum. This opening or break in the muscles has been designated the choledochal window.

The first sections are composed of curving arcs of muscle which in the beginning do not encircle the common duct completely, but fuse more distally, leaving no very large openings. These few sections, representing about 3.0 mm. of the original specimen are the distal limits of the muscle bundle designated by Schwegler and Boyden as the "pars superior of the sphinc-

ter choledochus" or "sphincter choledochus superior." (Figs. 1, 2, 3.) Hendrickson demonstrates them in Figure 32 of his

side of the model the thickness of the muscles is due partly to the difficulty in separating the two muscle systems when

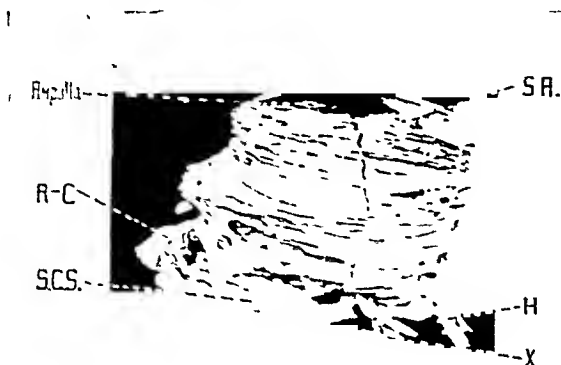


FIG. 1. The pancreatic side of the muscle system. R-C reinforcing and connecting fibers; S.C.S., sphincter choledochus superior; H, "11" fibers surrounding pancreatic duct; X, "X" fibers at choledochal window.

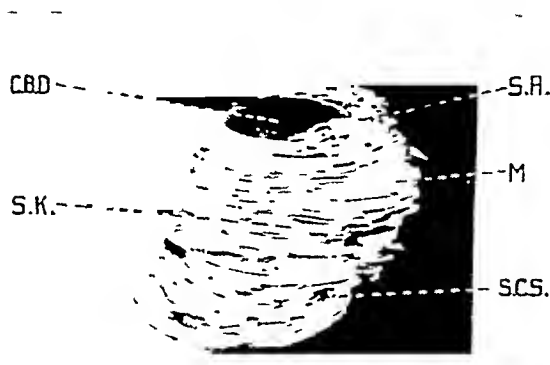


FIG. 2. The mucosal side of the muscle system. C.B.D. the lumen of the common bile duct; S.K. circular and longitudinal fibers; S.A., sphincter ampullae; S.C.S., sphincter choledochus superior; M, the level at which duodenal muscle entirely disappears.

original article, but does not mention them in the text. In the model this mass of muscle is quite irregular, part of it continuing around the common duct and part passing in closer to the common duct to connect toward the ampullary end with the sphincter choledochus inferior. (Fig. 1.) This maze of fibers represents the "R" and "C" fibers recently described by Kreilkamp and Boyden. These investigators have described as reinforcing or "R" fibers those strands of circular or longitudinal muscle of the duodenum which separate at the choledochal window to encircle the common duct in both directions and are continuous with similar strands from the other side at the same and different levels. These "R" fibers represent, they believe, postnatal development of the X 1, 2, 3, fibers (Hendrickson, Schwegler and Boyden). In addition to these there are connecting or "C" fibers, which originate similarly, but branch over from the duodenal longitudinal fibers to unite with the musculus proprius of the common duct.

On one side of the model off-shoots are clearly shown which probably represent the connecting fibers with the duodenal musculature. This blending of muscle fibers is so intimate in places that on the mucosal

making the camera lucida drawings. The outer portion of this band of fibers represent the "K" fibers of Hendrickson or "C" fibers of Kreilkamp and Boyden. (Fig. 3.)

On the pancreatic side of the model angled bits of muscle appear which develop into a shape like a cocked hat. These are the longitudinal "X" fibers of Hendrickson (Fig. 29 of his article), or "R₂" fibers of Kreilkamp and Boyden (Fig. 1, their article). It is interesting to compare these pictures with the illustrations of Nuboer (Fig. 14) and Schwegler and Boyden (Fig. 12, article 3). These fibers appear to anchor the bile duct to the choledochal window and by contraction to shorten the duct. Matsuno states that they may be distinguished from the intestinal muscles by the reduced width of their fibers. Schwegler and Boyden state that embryologically they develop both from the musculus proprius of the ducts and the intestinal muscle. Kreilkamp and Boyden support this statement by demonstrating muscular connections between them. Whatever their origin, they are important muscle fibers, since they definitely unite the two sets of muscles.

Musculus Proprius Ductus Pancreatici. The nomenclature used is that of Schwegler and Boyden. In the model just distal to the



FIG. 3. The common bile duct lumen of the bisected model has been removed. S-K, circular and longitudinal fibers. S.C.S., sphincter choledochus superior; S.A., sphincter ampullae; P.D., pancreatic duct; I.R. or S.C.I., independent ring or sphincter choledochus inferior; S.C.S., choledochus superior.

"X" fibers and connected to them, muscle bundles arranged in a semicircular manner are seen on the two sides of the pancreatic duct as it approaches the bile duct. Hendrickson designated these as "H" fibers. (Fig. 1.) These fibers gradually approximate so that in two areas the duct of Wirsung is completely encircled. (Fig. 3.) The muscle then frays out on the mucosal side of the duct. The other half of the muscle elongates and finally unites with the fibers coming from the other side of the bile duct. Nuboer states that "the muscle mantle around the D. pancreaticus has in the main the same structure as that around the D. choledochus," and that just before the union of the two ducts "the muscle of Oddi lies around both ducts in such a way that a figure-8-shaped structure arises." (Fig. 16, his article.) (Fig. 3.) Schwegler and Boyden disagree with this statement, saying that in fetal stages "only a few insignificant circular fibers on the sides of the pancreatic duct swing around between the two ducts." In Figure 16 of part III, Schwegler and Boyden illustrate such circular fibers branching over. In the model

in several areas circular fibers and Nuboer's "figure 8" arrangement are present. These fibers are so small and infrequent in comparison to the total mass of the muscles and to the longitudinal fibers present that at least in this specimen one must agree with Schwegler and Boyden. In adults, Krcilkamp and Boyden found a well developed sphincter pancreaticus in only four of twelve specimens, but usually these fibers do not appear strong enough to exert any important sphincteric action upon the pancreatic duct. Since most of these fibers are longitudinal, their function in the majority of individuals is more probably that of shortening the duct.

The Sphincter Choledochus Inferior. Hendrickson named this sheath of muscle fibers surrounding the common bile duct from the choledochal window to the juncture of pancreatic and bile ducts the "independent ring," differentiating from it the "S" or "sphincter" fibers which are continuous with it, but situated lower down on the mucosal side of the bile duct. (Figs. 29 and 30, his article.) Schwegler and Boyden found the muscle continuous in several fetuses (Fig. 6, part I, Fig. 8, part III) with the sphincter choledochus superior and suggested a more appropriate name would be the "pars inferior of the sphincter choledochus."

In this reconstruction this muscle bundle is about 5.25 mm. in length. (Fig. 3.) It has interruptions in its circumference but in the main is a continuous sheath of circular muscle fibers. Nuboer, and Schwegler and Boyden describe it as reaching its greatest development just before the ampulla. However, Schwegler and Boyden refer to an illustration in which the separation of the pancreatic and bile ducts is clearly shown in cross section, indicating that that area is an appreciable distance from the juncture of the two ducts. In this model the greatest thickness of this muscle is some 3 to 4 mm. from the juncture of the two ducts.

Despite the fact that this muscle was called the "independent ring" by Hendrickson, it is not an entirely separate

muscle system. In numerous places on the mucosal side of the ducts these fibers blend with the "S" fibers. (Fig. 3.) The model shows these fibers as one muscle mass. Indeed, as Boyden³⁴ points out, Hendrickson's "S" fibers are merely the mucosal side of a continuous sphincteric sheath which proximally is sphincter choledochus and distally is sphincter ampullae. Kreilkamp and Boyden found a well developed sphincter choledochus in all twelve specimens they examined. In any event, however, here exists a sufficiently separate muscle sheath which by contraction will close the common bile duct without effect on the pancreatic duct. This is the muscle which in pathological states causes the clinical condition known as biliary dys-synergia or dyskinesia. To postulate that these muscle fibers undergo pathological change independent of the other fibers appears questionable. It is more probable that all the fibers are equally affected and this ring is the only muscle mass so placed as to lead to clinical symptoms by its change.

The Musculus Proprius Ampullae. At the point where the duodenal musculature disappears there exists a definite thickening of the muscles, confined mostly to the pancreatic side. (Fig. 2, M.) Schwegler and Boyden in Figure 8, part III, also picture a thicker muscle on one side of the ampulla in a 52.5 cm. fetus. The reason for this is not apparent. It is at this point that many of the circular fibers become longitudinal. This would explain the sudden rather marked thinning out of the muscles distal to this area, but not the local thickness. It may be an attempt to fix this point at the last place where duodenal muscle is present. In this specimen the duodenal muscles separate entirely from the sphincter fibers about 3.25 mm. from the end of the ampulla and disappear 1.8 mm. proximal to the last sphincter muscle fibers. From the point of complete separation of the duodenal musculature and the musculus proprius out to the end of the papilla the muscle thins out, first on the mucosal side and then frays out

rapidly on the pancreatic side to disappear about 2.25 mm. from the end of the plicae longitudinalis. This muscle has been called the musculus proprius ampullae. (Figs. 1, 2 and 3.) Most of these fibers are longitudinal (X, K, H, S fibers), but circular fibers do exist, arranged in semicircular arcs partially encircling the bile duct. In the great majority of individuals it is evident that these fibers, while capable of sphincteric action, are much weaker than those farther back. It is doubtful, therefore, that their action can obstruct the flow of both the bile and pancreatic juice.

The ampulla in this specimen was of average depth. The first muscle tissue appeared 2.25 mm. from the end of the plicae longitudinalis, while the center of the junction of the pancreatic duct with the common duct was 1.5 mm. proximal to that point. These distances are probably more than the actual distances due to the cutting of the specimen on an oblique plane. The first complete ring of tissue occurs at the same place where the first muscle appears, so the ampulla is probably not more than 2 mm. in depth in this specimen.

Giordano and Mann²⁸ have shown that in 76 per cent of autopsies the ampulla was 2 mm. or less in length. Nagai and Sawada²¹ reported the average depth as 5 mm. On the other hand, Job²⁴ found an ampulla in only eight of 151 specimens. Baggenstoss³³ collected a thousand cases from the literature and reported that in 43 per cent no ampulla was found, while in many of the others the juncture of the ducts occurred not more than 1 to 2 mm. back of the apex of the ampulla.

There seems to be little doubt but what anatomical variations are important contributing factors in the production of clinical syndromes referable to this area. Thus, Kreilkamp and Boyden found a well developed sphincter ampullae in but two of twelve adult specimens. Giordano and Mann state that in approximately 20 per cent of patients reflux of bile into the duct of Wirsung is theoretically possible. These figures have been substantiated by the

cholangiographic studies of Leven,³⁶ and Colp and Doubilet.^{37,38} Clinically, it is interesting that about 25 per cent of patients with duodenal ulcer have associated biliary disease, suggesting that contiguous inflammation of a strong sphincter ampullae is the possible inciting agent.

It seems significant that all these percentages are approximately the same, suggesting that a strongly developed sphincter ampullae is the basic anatomical cause for the symptoms in this group of patients.

SUMMARY

A three-dimensional reconstruction of the intrinsic musculature surrounding the end of the common bile duct in man, generally referred to as the sphincter of Oddi, is presented. Here is visualized grossly for the first time the structure of the muscles in this important region in the adult human. A separate circular sheath of muscle is seen which by contraction can cause the clinical picture known as biliary dyssynergia. The model substantiates in the main and visualizes in three dimensions the findings reported by Hendrickson, Nuboer, Schwegler and Boyden, and Kreilkamp and Boyden.

Sincere appreciation is expressed for the encouragement and technical advice given by Dr. S. W. Chase, Associate Professor of Histology and Embryology, Western Reserve University, and to John F. Timmons.

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STERILIZATION means . . . the cutting of the spermatic duct in the male, a minor and easily accomplished operation, and the tying-off and cutting of the fallopian tubes in the female, a difficult operation but still not in the class of the major or dangerous procedures.

From—"The March of Medicine"—New York Academy of Medicine (Columbia University Press).

PERIPHERAL ARTERIAL OCCLUSION*

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THIS report is based upon experience gained in a special clinic which has been conducted for over six years at Roosevelt Hospital for the diagnosis, study and treatment of arterial disease of the extremities. It is not an attempt to review the subject, but simply an analysis of some salient features which have impressed me personally during the observation of these cases.

The most valuable contribution of such a clinic is early recognition of peripheral arterial disease. The process can and should be recognized in its early stages, long before the damage is severe enough to cause serious disability. Very few doctors in doing a general physical examination are sufficiently interested in the arteries of the legs and feet. The disease can be detected, frequently, years before any clinical symptoms develop. The margin of safety in the peripheral circulation is so great that even mild clinical manifestations may be late in the pathologic process, and gangrene, though often the first condition for which the patient asks treatment, is an extreme end result. Consider the circulation of the lower extremity of the young athlete capable of running a mile in less than five minutes, and compare it with the condition in which the circulation is so reduced that the basic nutrition of the tissues cannot be maintained. The contrast is amazing. Based upon quantitative metabolism studies, it is probably reduced to less than one-half of 1 per cent.¹ The functional capacity of the circulation very much exceeds the requirements of the basic nutrition of the tissues. The reason for this is obvious when one considers that the peripheral circulation is designed to meet, with a margin of

safety, many functions in addition to simple nutrition, such as the regulation of body heat, the supply of muscle energy and the mobilization of resistance to infection—any one of which may require at times a much larger amount of blood than the basic nutrition of the tissues. The usual case of arteriosclerosis and thrombo-angiitis obliterans progresses slowly over many years so that it should be possible to detect the process in the preclinical stage. Early subjective symptoms, such as easy chilling and fatigue, burning and tingling of the feet and slight muscle pain after unusual effort may not result until the pathologic process is of long standing. Even when symptoms are well established, these cases are frequently incorrectly diagnosed as flat feet, muscle strain, arthritis, neuritis or rheumatism. They are operated upon for an ingrown toenail or a painful callus, or perhaps injected for varicose veins, sometimes with disastrous results. A department in the hospital where the condition of the peripheral arterial circulation can be accurately appraised serves a very useful purpose. Every diabetic patient should be periodically examined and accurate records made of the condition of the circulation. Even in advanced cases in which little can be done to improve the situation, it is of great help to the patient and to the doctor to know the facts.

Patients without gangrene or open lesions can be taught how to get along comfortably with their limitations and how to prevent progression and complications. A simple routine is all that is necessary for this in most cases. During the last six years only one patient has come to major amputation who had presented himself to

* From the Vascular Clinic of Roosevelt Hospital, Dr. Grant P. Pennoyer, Director.
Read before the New York Surgical Society, May 8, 1940.

the clinic before open lesions or infection had set in. Salient features of this routine are mental and physical rest, very warm clothing for the entire body even in mild weather, including long woolen underwear, woolen stockings and high, soft orthopedic shoes. Abstinence from smoking is essential for the arteriosclerotics as well as the Buerger cases. I do not believe a diabetic, even though he has no arterial occlusion, should be allowed to smoke. The rate and amount of walking and all activity is kept below the level of muscle pain. I am very explicit in my advice as to the care of the feet. I insist that they be bathed morning and evening in lukewarm water with castile soap and the nails scrubbed with a soft brush. Exact directions are given as to how the nails should be cut and the type of stockings and shoes to be worn. Corns and diseased nails are cared for by the doctor.

For the ambulatory cases without open lesions, I am very skeptical as to the permanent value of any type of physiotherapy treatment, medication, injections or special diets. These people are chronic sufferers whose symptoms are often helped by most any treatment. They are encouraged by and very appreciative of all attention. Subjective improvement is very common by every method of therapy, but I doubt if anything known affects appreciably the arterial capacity in cases of arteriosclerosis or thrombo-angiitis obliterans. I have never been able to demonstrate any considerable objective improvement after popular methods of treatment, such as vacuum-pressure therapy, intermittent venous occlusion, hypertonic saline infusions or injections of pancreatic and other tissue extracts. Drugs have only a fleeting effect at best. The thrombo-angiitis cases occur in much younger people, and those who have come to the clinic while there is still a fair circulation and have followed instructions carefully, have done exceptionally well during my period of observation. The diabetic arteriosclerotic patients are the most discouraging group.

The normal control of the circulation,

that is the mechanism of regulating the supply of arterial blood to the demand, needs much elucidation. The emphasis in the literature and in the minds of clinicians has been placed on the control by the nervous system through the autonomic nerve supply. As is well known, this is accomplished through nerve cells in the spinal cord which connect by preganglionic fibers to the sympathetic ganglia, in which the impulses are relayed to postganglionic fibers which join the peripheral nerves to be distributed to the blood vessels. The nervous system via these sympathetic ganglia maintains a definite vascular tone which is usually symmetric. It is concerned with the regulation of body temperature, much of the heat radiation being from the extremities. It is sensitive to emotions, such as anger, worry and embarrassment. Excess body heat and mental peace are good eliminators of the vasospastic element of vascular trouble. A warm climate is of great help, as even a cold wind in the face may induce reflex vasoconstriction.

However, this reflex nervous control is not the only regulator of the arterial circulation of the extremities. The major adjustment of the arterial supply to the demand is through the metabolite control, largely, if not entirely independent of the nervous system.^{1,2,3} This subject was well brought out in the 1935 Harvey Lecture by Anrep.² There is something in the end products of the metabolism of the tissues which causes vascular dilatation. This is probably some histamine-like substance and carbon dioxide. Thus, if a muscle or any tissue is put into increased activity, the accumulation of its own metabolites causes vasodilatation to supply the increased blood demand. The blood supply of a muscle or any tissue is automatically regulated by the speed of its metabolism, a process having no relation to the nervous system.²

This is the mechanism and stimulus of the development of collateral circulation.³ If the normal arterial blood supply is cut off to any given area, the collection of the

tissue metabolites which results from the arrest of the circulation causes local dilatation of the remaining anastomosing channels. Thus, an area of increased vascularity results, and blood is automatically brought to the area by the available routes which are still intact. Even in recent medical literature one still finds occasional mention of the old increased pressure theory of collateral circulation, the idea being that if a large arterial highway is shut off, the resulting increase in blood pressure dilates the remaining channels.⁴ This is quite erroneous. Pressure has little or nothing to do with the development of collateral circulation. Very extensive arterial occlusion of the extremities does not affect the blood pressure. In my experience, a low blood pressure is found in most cases of thrombo-angiitis obliterans and in many cases of arteriosclerosis with very advanced peripheral occlusion.

This metabolite control of the circulation, when the nutrition of tissues is impaired, puts in abeyance the control by the sympathetic nervous system.^{1,2,3} The reactive hyperemia test of the spastic element in the peripheral circulation depends on the predominance of the metabolite control.^{3,5,6} If the arterial circulation is cut off by a tourniquet for a few minutes, an oxygen debt and metabolite accumulation are created in the tissues, which in the normal leg gives a vasodilatation and hyperemia as soon as the tourniquet is released. The degree of hyperemia has been established within certain limits to be in direct quantitative proportion to the degree of oxygen debt.^{5,6} The vasomotor tone of the nervous system is temporarily suppressed by the local metabolite control. When the arterial circulation is so diminished that gangrene is imminent, all demonstrable vasomotor tone is abolished in nature's effort to preserve the tissues. In this condition, vasospasm no longer plays a part. I, personally, have yet to see gangrene in arteriosclerosis or Buerger's disease in which arterial spasm from the nervous system was an appreciable factor. I am well

aware of the fact that considerable medical literature and tradition are not in accord with me in this.

When the circulation is arrested and gangrene is imminent, there is marked vasodilatation to the point of paralysis of all the capillaries and arterioles which become filled with deoxygenated blood. This is the cause of the familiar congested purplish color of the feet in these cases. When the feet are held down they have the same cyanotic congested appearance as the dependent portions of a fresh cadaver. When the part is elevated and sufficient time is allotted for the paralyzed vessels to empty by gravity, the ischemic skin becomes the light lemon-yellow color seen in the morgue. As a matter of fact, the condition of the circulation closely approaches that of the cadaver. In both, all vasomotor tone is gone and the circulation arrested.

The paralysis of the capillaries and arterioles due to the local accumulation of metabolites explains phenomena observed in the peripheral vascular clinic, the mechanism of which was formerly unknown. The change in color of the feet in the dependent and elevated positions, I have just mentioned. Close observation of this appearance of the skin of the extremities in the two positions in a warm room becomes a circulatory test of great value. It is significant if a very faint pink blush of oxygenated blood remains in the skin of the toes after the foot has been elevated above the heart level for several minutes. This blush should disappear on pressure and then slowly return. This means some oxygenated blood is entering the dilated capillaries against the force of gravity and gangrene is not imminent even if it seems inevitable and the oscillometric readings are zero. It is important that the foot be warm in making this test. One can sometimes obtain this sign when the symptoms and physical findings indicate that the circulation is practically gone. In the extremity suddenly shut off from its main arterial circulation by a large embolus, huge areas of ecchymosis, blebs and in-

tense inflammation appear in the zone of borderline viability. This is a result of the extreme vasodilatation occurring automatically from the metabolite accumulation in tissues still viable but deprived of their circulation. All vasomotor tone is abolished and the capillary paralysis results in diapedesis of red blood cells and extravasation of serum. This phenomenon in varying degrees is very common in peripheral vascular occlusion of all types.

One can deduce from these facts the value of most of the sympathetic nervous system surgery in the ordinary case of arteriosclerosis and thrombo-angiitis obliterans. A considerable rise of the temperature of the skin of the feet resulting from some form of nerve block, is considered by many an indication for sympathetic nerve surgery on account of vasospasm, or vasotone, as I prefer to call it.^{7,8,9} A study of the temperature of the extremities before and after blocking the nerve supply does give an indication of the degree of vascular tone maintained by the nervous system. However, this rise in skin temperature is very marked in the normal individual, and is not an indication for extensive surgery. It must be proved: First, that this vascular tone is abnormal; that it is the cause of the trouble; and, also, that it cannot be abolished in some much simpler manner. Frequently heat applied to the trunk will cause as much temperature rise in the feet as sympathetic block, and why resort to surgery if woolen underwear will accomplish as much? I particularly object to considering an indication for surgery the elevation of the cutaneous temperature resulting from an intravenous injection of typhoid vaccine.^{7,10} Here, the change may be due to many other factors besides release of vasotone, such as increased blood temperature, increased heart output and changes in the blood itself. The same type of objections pertain to using as a test the effect of an intravenous injection of sodium nitrite.¹¹

Cases showing a rise of skin temperature after nerve block are those with an arterial

system still elastic enough to be capable of improvement and are, therefore, the best group for any method of therapy. An increase of temperature means dilatable arteries and a favorable prognosis by non-surgical treatment. The more marked the rise, the more elastic the arteries, and the more favorable the outlook. Good results after sympathectomy must, therefore, be interpreted with great caution. This is particularly true of the group who have had some recent episode, such as an embolus, infection or sudden thrombosis of a major arterial trunk, processes frequently superimposed on chronic vascular pathology. These cases will often improve spontaneously when the condition seemed hopeless for a considerable time. If dilatable arteries are still present in an area of arrested circulation, the metabolite control will give maximal dilatation, and the elastic artery on which increased demands are put will gradually hypertrophy over many months of time.³ I have had an opportunity to follow nine cases which have had sympathetic nerve block. Five of these fall in the thrombo-angiitis obliterans group and four in the arteriosclerotic. Judging by the absence of sweating and the measurement of skin temperatures, I believe the operation had been well performed. I could not see that the course of a single one of these patients differed in any way from the usual one without surgery. Several others had had the Leriche type of periarterial sympathectomy, which I also consider of no value. Mention is made recently in the literature of sympathetic nerve block being performed to secure a hot, dry skin to cure certain special cases of athlete's foot.^{7,12,13} Many patients are operated upon just to be sure there is no element of arterial spasm. I recently heard of a woman without any arterial occlusion symptoms having a bilateral lumbar sympathectomy performed to cure an unsightly cyanosed appearance of her feet which appeared on bathing in cold water. These seem to me extreme samples of surgical enthusiasm.

Temperature studies of the feet are important. I have found the temperature of the feet in most of the advanced cases of arterial occlusion approximately that of the environment regardless of any nerve block. The feet in these unfortunate individuals are like a cold-blood animal, in that they assume practically the temperature of the surroundings and adjust their metabolism to this temperature.¹⁴ Therefore, in treating advanced cases with open lesions and pain, the temperature control is very important. The feet are kept in a bed cradle in which the temperature is kept about 92°F., by a thermostat which is about the temperature of the normal extremity. No method of treatment contributes more to the comfort of these patients than this simple device. The leg assumes almost the same temperature as the atmosphere of the cradle. If it is higher than 92°F., the local metabolism is elevated; this increases the discrepancy between tissue demand and blood supply and causes pain.^{14,15} Even a rise of one or two degrees may start burning pain in a leg which has been previously perfectly comfortable. A diminution of temperature below 90°F. brings in some vasospasm as the direct result of chilling and likewise leads to discomfort. It is not at all uncommon to have patients with gangrene, who have been unable to sleep because of excessive pain despite large doses of a very strong sedative, rest comfortably without medication as soon as the thermostat control of the temperature to 92°F. in the bed cradle is instituted. I have seen this simple device straighten out many elderly people who were formerly completely exhausted by pain and depressed by excessive sedative medication.

Very few of my patients, even with extensive gangrene, who are kept in these cradles at constant temperature, require any sedative medication. If pain suddenly recurs, one usually finds that something has gone wrong with the thermostat. I consider the thermostatic control of the temperature of the bed cradle one of the greatest contributions to the therapy of

these cases. Its very simplicity leads some physicians to ignore it. Hot water bags, heating pads and even baking machines are still employed on these cases. No form of heat should ever be employed except heat thermostatically controlled. In addition to causing pain, the danger of burning is very great. The cutaneous sensation in severe cases is very dull or completely absent, so that the patient has no warning of the damage. In addition, there is no circulation to conduct away the heat. A hot water bag which feels just comfortably warm on the skin of the face may cause a bad burn to the feet of these patients. The intact circulation tries to keep the skin cool in the presence of excess heat, just as it tries to keep it warm in the presence of cold. If the circulation is arrested, the full heat of the hot water bottle is gradually transmitted to the skin which is blistered by a temperature which feels perfectly safe to the most careful nurse. Diathermy, heat lamps, ultra-red and baking machines are particularly bad. In addition to burning, the excess heat may precipitate a gangrenous process by increasing the discrepancy between the blood demand and blood supply.¹⁴

Another most important consideration in treating an advanced case of peripheral arterial occlusion is absolute, prolonged body rest. Active muscles require much more circulation than the basal metabolism of the tissues. This is easily demonstrated by quantitative metabolism studies.¹ When the blood supply is so reduced that even the basic nutritional need of the tissues is endangered, all other demands on the circulation must be eliminated as completely as possible to allow the remaining circulation to be used solely for nutrition. To allow the patient up and about, even to go to the toilet, uses up the available oxygen in the muscles before it reaches the feet. It is similar to opening wide, large water outlets in the basement of a house with poor pipes when one is trying to get a supply on the top floor. For this reason a patient with an unhealed ulceration, a local

infection or imminent gangrene must be kept constantly in bed. I believe that even Buerger's exercises, when they have to be undertaken by the patient's own muscular energy, do more harm than good. When they can be done without any effort on the part of the patient, as in the case of the Sanders' oscillating bed, I believe they are physiologically sound and of value.

It is amazing what can be done with cases of demarcated gangrene of the feet and indolent ulcers by these two simple physiologically sound measures, complete bed rest and controlled temperature at 92°F. It takes weeks and perhaps months, but healing which seemed impossible can often be accomplished. The indications for major amputation are still sometimes a matter of dispute among our own staff. Of course, immediate amputation is necessary as a life saving procedure if a patient with advanced arterial occlusion, with or without diabetes, has rapidly spreading gangrene associated with acute infection, fever and leukocytosis. If the process will localize, I am very much on the conservative side of the question. It is important that one man experienced in this work follow the case and do all surgery and dressings himself. In cases of well limited gangrene, operations are dangerous proximal to the productive inflammatory area of the demarcation zone. This zone, like granulation tissue, is more resistant to infections than freshly incised tissues. It is safer not to perform any local amputations until the separation of the living and dead tissue is almost complete which may take many weeks. The gangrenous tissues can then be eased off through the demarcation zone without undue difficulty. No other surgery is performed except simple incisions for drainage. Sloughs should be allowed to separate spontaneously. When a clean granulating base is obtained, small full-thickness skin grafts will often "take."

In trying to encourage epithelium to grow over indolent ulcers, no antiseptics whatsoever should be employed and the parts should be kept clean with normal

saline solution. The delicate, growing epithelial edge from the sides of a sluggish ulcer acts very much like a tissue culture which is discouraged by even mild antiseptics, such as peroxide. Gauze is much too rough and shifting to be used as a dressing. Adhesive tape sterilized by passing it over an alcohol flame works well. It does not stick to the wound and forms a smooth, immobile surface under which the epithelium grows readily. This dressing is satisfactory even if there is some purulent discharge, provided the dressing is changed daily. Scrupulous care as to the cleanliness of the skin and nails and avoidance of the slightest trauma are essential. Whirlpool baths are excellent. Warm bed jackets and long wool-lined bed boots are helpful. The head of the bed should be elevated so the foot is a few inches below the level of the heart.

The most favorable patients for this type of therapy are the younger people with thrombo-angiitis obliterans. Only two cases of this disease have come to major amputation. It is also well worth while working with the diabetic and arteriosclerotic groups. Feet with advanced gangrene and infection which seem hopeless sometimes turn out quite well after many weeks or even months of patient care. One often hears the argument that if the circulation is so badly damaged that gangrene has resulted, it is foolish to expect healing, and the foot would be useless if one obtained it. I have many cases to refute this argument and many are reported in the literature.¹⁶ The most discouraging group are the diabetic patients. It is saddening to work several months to get a gangrenous foot well for one of these patients and have him return in a few weeks with another process. However, it is just as apt to be on the other foot; and if one has performed a major amputation already, it is doubly upsetting to have the other side start. This is such a common occurrence that I believe major amputation should not be performed until one is convinced that it is a life saving procedure.

If amputation is to be performed, very careful studies should be made to select the site. It is not at all necessary to amputate in all diabetic and arteriosclerotic gangrene patients above the knee, as has been frequently taught. Personally, I have used the oscillometric readings and the skin temperatures to select the level and have found them to be very satisfactory. Every effort should be made to save the knee joint as it greatly simplifies the patient's problem with the prosthesis. A stump containing six inches of tibia and a good knee joint is ideal and allows the use of as simple a prosthesis as any amputation at a lower level. I have not used the Gritti-Stokes, Callendar or any amputation designed for weight-bearing on the end of the stump, as we believe the most successful type of prosthesis does not use end weight-bearing. The pressure is distributed over the whole area of the stump and skin necrosis is avoided. If one does not wish to risk performing an amputation in the leg, a midhigh amputation is the next choice. A midhigh prosthesis is about as satisfactory as one in the lower thigh or through the knee. We have no amputations above the midhigh, although I have seen cases in which the operator in forcibly retracting the muscles did not realize that he was amputating the femur above its center.

OPERATIVE TECHNIC

The technic of the operation is extremely important. We are dealing with tissues with damaged circulation in which there is almost surely infection in the lymphatics, and the greatest care must be taken to avoid trauma. Even slight insult to tissues predisposes to infection and necrosis. Forceps and towel clips should not be used on the skin. The scalpels should be extremely sharp and incisions bold. Hacking of the fat and muscles with repeated small strokes of the scalpel leaves devitalized bits of tissue which invite trouble. Hemostats should be placed on the vessel alone and not include large pieces of other tissue.

I am convinced the best operation is a modified guillotine. I am opposed to any incision which makes skin flaps. When skin flaps are used, the first sign of trouble is often necrosis of the edge of the longer flap. A circular incision obviates this condition. This brings the scar over the end of the stump, but this does not interfere with the present type of prosthesis. The skin incision, which is carried right down through the deep fascia with one bold stroke of a sharp scalpel, encircles the leg about three inches below the level selected for the bone division. No skin or subcutaneous tissue is raised from its deep fascial connection. In this way, the nutrient arteries to the skin which lie in the deep membranous layer of the superficial fascia are not disturbed and the maximal arterial supply to the skin edges is maintained. The skin, fat and deep fascia retract upward almost without dissection and the muscles are divided about two inches higher, and the same care should be taken to use a very sharp scalpel to avoid any hacking of the tissues. An amputation knife does this stage of the operation best. No tourniquet is employed except hand compression by the second assistant. This avoids any arterial damage by a tourniquet, and it is important to know just how much arterial bleeding there is. An experienced operator can identify and grasp the main vessels as soon as they are divided. The muscles are retracted, the periosteum peeled back and the bone divided about one inch higher than the muscles. If the amputation is through the tibia, it is extremely important to bevel the anterior edge very acutely so the sharp subcutaneous corner cannot cause subsequent pressure on the skin flap. The fibula is divided slightly higher than the tibia. It is not necessary to inject the nerves with alcohol or to cauterize them. Each large nerve should be identified, stripped back and divided high above the level of the incision. This insures against sensitive nerve endings being caught in the scar. With this simple method I have had no painful stumps or neuromas. It is of

paramount importance that not a single suture be placed in the muscles or fascia. None is necessary. Sutures put pressure on the circulation which is aggravated later by postoperative edema, and they tend to close the fascial layers which should be left wide open for drainage. Fascial and muscle sutures are particularly contraindicated in amputations performed in the presence of severe foot infections. The skin is closed by very few skin clips or stainless steel wire sutures one to two inches apart. If the skin is as loose as it should be, the edges should fall together almost naturally and only

bloody serum for a few days, promptly heal and result in a satisfactory stump.

Table 1 gives a synopsis of all the patients with gangrene resulting from arterial occlusion, admitted to the surgical wards of Roosevelt Hospital during the last six years.

This series is much too small to be of any statistical value, but I wish to call special attention to the high percentage of toe and leg amputations as compared with the mid thigh. The diabetic patients have the highest hospital mortality. The mortality rate of the whole group is about 15 per cent. Most of the deaths were in senile, debilitated patients with advanced disease. Since Welfare Hospital was opened in August, 1939, we have performed ten major amputations on the Second Surgical Division for arteriosclerotic and diabetic gangrene, employing this technic without a single death.

The distribution of cases of arterial disease in the Out-Patient Department without open lesions is shown in Table 11.

TABLE I
SYNOPSIS OF CASES ADMITTED TO THE HOSPITAL WITH
FRANK GANGRENE
Total Number of Cases 61

	No. of Cases	Thigh Amputations	Leg Amputations	Toes and Parts of Toes	Hospital Mortality
Arteriosclerotic . .	24	5	6	13	2
Diabetic	22	3	6	13	4
Thrombo-angiitis obliterans	12	0	2	10	0
Embolic	3	1	1	1	1

three or four sutures are necessary. This allows very free drainage without the use of any irritating foreign body such as rubber tubing, etc. The circular incision will leave a corner on each end which can be trimmed down if it is too redundant, but it is better not to worry about it. Experience shows that later on the skin tends to conform very naturally to the shape of the stump and the cosmetic result is quite satisfactory. This operation provides almost as free drainage as a true guillotine amputation, which is undoubtedly the safest operation in the presence of severe infection, and at the same time it avoids the difficulties associated with exposed bone and muscle. The whole operation does not take over twenty minutes, and there seems to be a minimum of shock and postoperative pain. Most of them drain a considerable amount of

TABLE II
CASES TREATED IN THE OUT-PATIENT CLINIC FOR
PERIPHERAL VASCULAR OCCLUSION WITHOUT OPEN
LESIONS
Total Number of Cases 198

	No. of Cases	Approximate Percentage of Total
Arteriosclerotic	120	60
Thrombo-angiitis obliterans	24	12
Diabetic arteriosclerotic	42	21
Spastic conditions (Raynaud's, etc.)	6	3
Embolic	4	2
Others	2	1

SUMMARY

1. The value of a special clinic for the study and treatment of peripheral arterial occlusion is emphasized. It makes for early recognition, accurate diagnosis and successful management.

2. The physiology of the control of the arterial circulation is outlined. In cases of advanced arterial occlusion, the metabolite

control puts in abeyance any arterial spasm and makes surgery of the sympathetic nervous system valueless. Cases showing improvement of the circulation after nerve block are favorable cases for nonsurgical treatment.

3. A plea is made for conservative treatment of demarcated gangrene when amputation is not necessary as a life saving procedure.

4. The regulation of the temperature in the bed cradle to 92°F. by a thermostat is one of the most important features in conservative treatment. The other is complete bed rest.

5. A modified guillotine amputation without sutures in the muscle or fascia, is recommended as the safest operative procedure.

6. The statistics of the amputation cases are given, showing a preponderance of toe and leg amputations, even in cases of arteriosclerotic and diabetic gangrene.

7. The distribution of cases treated in the Out-Patient Clinic is given, the frequency being in the following order: Arteriosclerosis, diabetic type, thromboangiitis obliterans, spastic arterial disease, embolism and others.

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UTERINE PROLAPSE

AN X-RAY STUDY

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PROPER evaluation of relaxation of the supporting ligaments and descent of the uterus often presents a difficult problem. Particularly so in the milder cases in which the patient complains of sense of weight in the pelvis, backache, discharge and pain on standing and the only objective findings may be increased mobility, congestion of the uterus and varicosities in the broad ligaments.

The human equation enters into the decision as to whether or not a moderate degree of descent is responsible for the symptoms manifested, and our best test is the symptomatic response to support. In the advanced degrees of prolapse the condition is obvious and the only problem is that of treatment.

The frequent industrial and automobile injuries often create situations in which it is most difficult for the gynecologist to give a definite answer. A typical case is one in which following an injury a patient who has previously been well complains of backache, discomfort on standing and the usual attending symptoms. There may, or may not have been bony injury. Examination shows the uterus in good position with some relaxation of the supporting ligaments. The patient states that rest and support relieve her symptoms, but such a statement, like the symptoms complained of, may be colored by the desire for compensation. It is in such a case, that capable gynecologists may differ in their opinions as to the existence of sufficient damage to account for the symptoms. A recent case in court, with several capable experts expressing opposite opinions, convinced the writer for the need of some more objective method of evaluating such a condition. A search of the literature revealed little of assistance,

therefore, this study was begun in the hope of being able to express in definite figures the normal ascent and descent of the uterus, and to create some sort of yardstick with which abnormal mobility might be measured.

In hysterosalpingography advantage of uterine mobility is often taken to bring into view tubes that are otherwise obscured by the uterine shadow. This gave rise to the thought that with minor changes in technic, the uterine excursion might be directly measured on the x-ray film. The relative position of the fundus, anterior or posterior, was not considered of importance. It is true that acquired retroversions cause symptoms, but then there are usually additional findings together with congestive changes in the pelvic organs. In the normal pelvis the point of attachment of the cardinal ligaments represents the most firmly fixed point of the uterus. Measurement of longitudinal mobility at this point would accurately measure the mobility of the entire organ. This, however, offers difficulties, but the tip of the intracervical cannula lies just below and in constant relation and provides a satisfactory substitute. With the cervix firmly held in the same position relative to the long axis of the body, measurement of the cephalad and caudad excursion of the cannula within the cervix provides a satisfactory and convenient method of determining such mobility. Measurements from the upper border of the symphysis pubis to the tip of the cannula give the relative position and the exact amount of mobility.

TECHNIC

The patient is positioned on the table as for a gynecologic examination, and a tube

distance of thirty inches is used. In exposing the cervix a speculum with a divided anterior blade is desirable so that it may

in place there is a certain amount of splinting of the vaginal walls and limitation of motion. Taking care to keep in the long

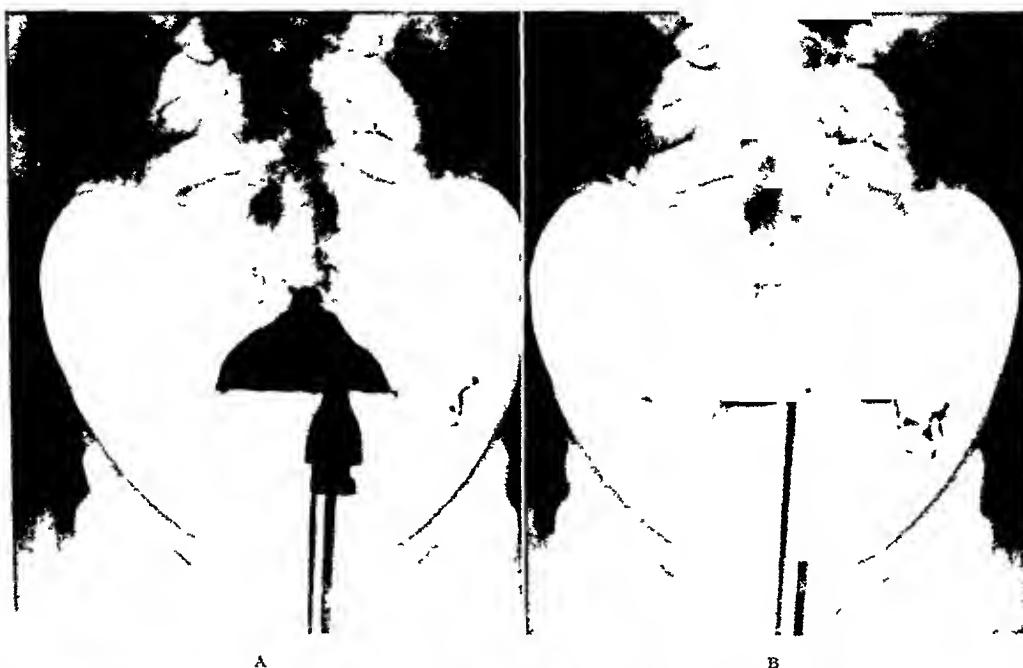


FIG. 1. A and B. Case 7. Normal anteverted uterus. Low and high positions.

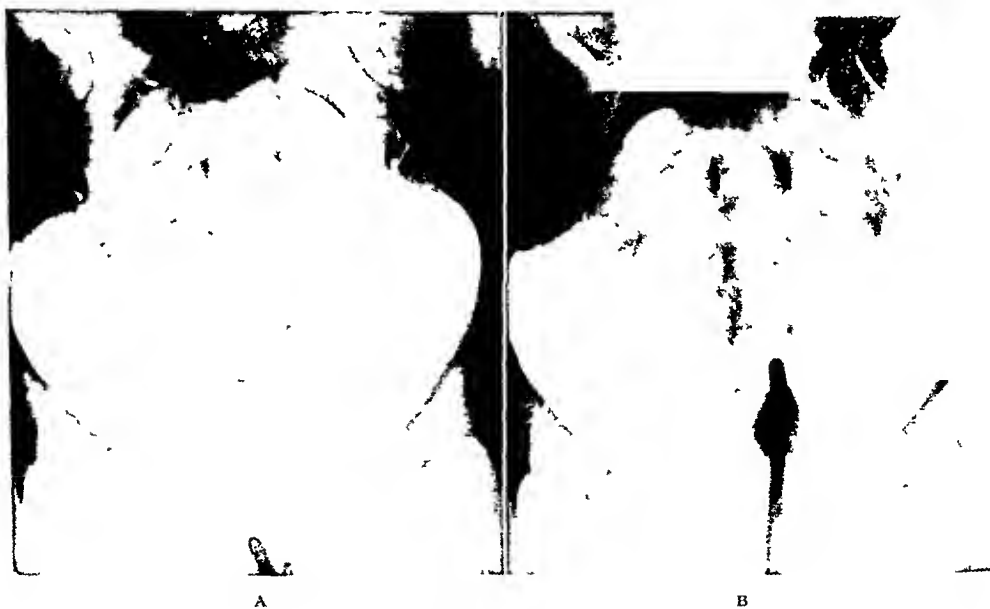


FIG. 2. A and B. Case 3. Second degree prolapse with marked symptoms preoperatively. No contrast material used.

later be slipped out of the vagina without disturbing the cervical tenaculum or the cannula. After the desired number of films using varying amounts of contrast media have been exposed, the speculum is removed from the vagina. With the speculum

axis of the body, the uterus is pulled as far downward as possible and a film exposed. Next, the procedure is reversed and a film is made with the uterus at the cephalad limit of its excursion. In this maneuver pressure is made on the uterine cannula

and the cervix is steadied by the tenaculum. Measurements taken from these two films give the upper and lower limits of motion. In this work the Hyams cannula has been found most convenient and has been used routinely.

space, and traction only serves to fix it more firmly in the cervix.

For the purpose of obtaining standards from which conclusions might be drawn twenty-five cases were studied. All but three were consecutive cases in which

TABLE I

Case No.	Age	Weight	Gravida	Para	Diagnosis	Pressure Symptoms	Low in Cm. above Pubis	High in Cm. above Pubis	Long. Mobility in Cm.	Comments
1	32	108	4	3	Fibroids	0	6	8	2	Bleeding main symptom
2	60	122	12	10	Prolapse	3+	—5	3.5	8.5	Fair comfort with pessary
3	29	167	3	3	Prolapse 2°, preoperative	3+	—1.5	5	6.5	Unable to carry on with household duties
4	20	167	3	3	Same case, postoperative	0	3.5	7	3.5	Postoperative—well
5	25	110	0	0	Ov. cyst, salpingitis, sterility	1+	2	6.5	4.5	Previous tubal masses, large cyst on right
6	33	140	4	0	Fibroids, sterility	0	6	8.5	2.5	Intraligamentous fibroid
7	19	96	0	0	Sterility	0	7.2	10.	2.8	No symptoms
8	27	101	0	0	Sterility; gen. ptosis (injury)	1. +	3.5	8	4.5	Symptoms after several months in east
9	26	106	2	2	Fibroids, chr. salpingitis	1+	1.5	6.7	5.2	Relief with pessary
10	30	170	6	2	Fibroids	1. +	.6	4.8	4.2	Constant complaints; neurosis
11	48	165	0	0	Fibroids	0	6	9.5	3.5	Bleeding, D and C and radium
12	44	133	1	1	Fibroids	0	3.5	6	2.5	Bleeding only symptom
13	24	120	1	1	Sterility, salpingitis	1. +	3	7.2	4.2	Relieved by treatment
14	33	91	1	1	Sterility, salpingitis	1. +	1.5	5.5	4.	Repair since; relieved
15	33	125	0	0	Sterility, salpingitis	0	5	6.8	1.8	Old salpingitis
16	42	155	0	0	Sterility, postoperative	0	5.3	8.	2.7	No symptoms
17	35	171	0	0	Sterility, salpingitis	0	8.5	10.5	2.	No symptoms
18	35	134	2	1	Sterility, salpingitis	0	6.6	8.7	2.1	No symptoms
19	25	115	1	1	Sterility, salpingitis	2+	3.3	7.1	3.8	Recurrent pelvic cellulitis at time of examination
20	26	108	0	0	Sterility, salpingitis	1+	3.	8.5	5.5	Previous large tubal masses, now pregnant
21	24	115	0	0	Sterility, salpingitis	0	4.	7.	3.	Hystero. account sterility
22	28	190	0	0	Sterility, salpingitis	0	5.8	7.3	1.5	Hystero. account sterility
23	27	110	0	0	Sterility	0	3.5	7.	3.5	No other symptoms
24	25	190	1	1	Sterility, salpingitis	0	6.5	9.5	3.	Mild salpingitis and sterility since labor
25	24	108	0	0	Sterility, salpingitis	1. +	1	5.5	4	Appendicitis; pelvic peritonitis five yrs. before

The usual cervical tenaculum was found to be unsatisfactory in several ways. When traction is exerted, the instrument usually tears out. If a more adequate bite is taken, the direction of the cervix is changed and the canal may be partially blocked. To obviate these difficulties a new instrument which has recently been described was devised.¹ This tenaculum requires less

hysterosalpingography was done for some indication. In the three selected cases films were made in the same manner but without the injection of the contrast material. When the amount of relaxation is the only question, the shadows of the instruments without the outline of the uterus are adequate for measurement and this procedure saves both time and expense.

In considering the data obtained, it must be noted that the figures given are only relatively accurate. There is a slight magni-

The findings together with a few pertinent facts regarding each case is given in Table 1. Most of the columns are self-



FIG. 3 A and B. Case 4. Same patient postoperatively. No symptoms.



FIG. 4 A and B. Case 11. Normal mobility. Submucous fibroids and cavity in cervix considered possible early endocervical carcinoma, negative on biopsy. Hyams cannula and author's tenaculum.

fication in the x-ray film and there is another variant depending on the depth of the pelvis. However, these are not significant and if all films are made under standard conditions, the measurements taken directly from the films are satisfactory for drawing conclusions.

explanatory. As previously stated, these were all private patients seeking diagnosis and relief of symptoms. None of these patients was involved in litigation or had any object in misstating symptoms or their relief. Pressure symptoms were not accepted as being present unless relief was

obtained by support. For convenience, pressure symptoms were arbitrarily graded as from one to three plus. One plus were

3.8 to 8.5 cm. In Case 19 with 3.8 cm. motion there was a rather acute pelvic infection associated with the relaxation.

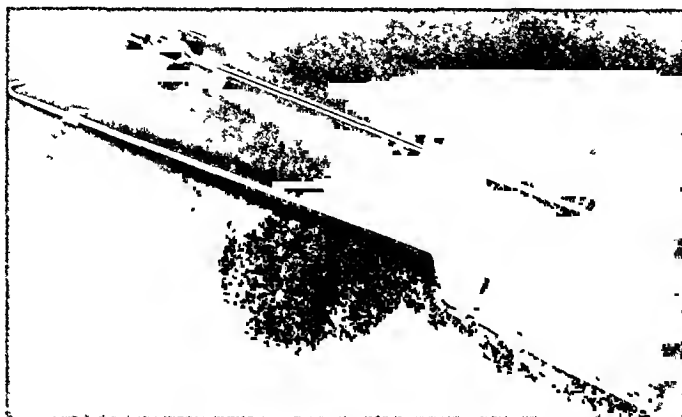


FIG. 5. Hyams cannula and author's tenaculum.

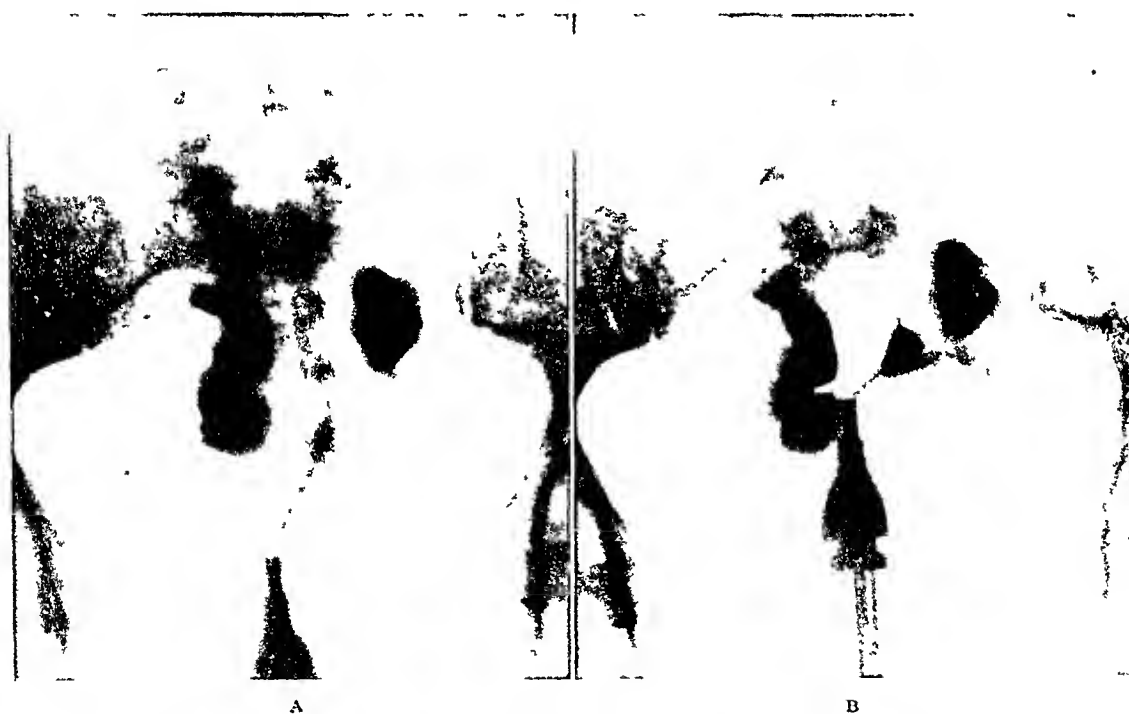


FIG. 6. A and B. Case 5. Abnormal mobility. Bilateral hydrosalpinges and large right ovarian cyst. Films made with viscous skiodan. Uterine shadow in 6A lost due to absorption.

patients with mild symptoms who obtained complete relief with occasional treatment. Two plus were those with more definite symptoms and who exhibited some discomfort in spite of more or less continuous treatment and of sufficient intensity to consider surgical relief. Those graded as three plus had symptoms severe enough to limit their activities definitely and surgery was necessary.

In eleven cases that manifested pressure symptoms, the uterine motion varied from

The position of maximum descent relative to the symphysis in this group varied from -5 to plus 3.3 cm. The smallest deviation from the normal was manifested by the patient with associated pelvic inflammation. It might be added, that this patient failed to mention the recurrence of her pelvic infection until after the examination was made. Among the women in this group seven or 63 per cent had borne children. Two of the other four, Cases 5 and 20, had had large tubal masses, and Case 5 still

presents a large right ovarian cyst. No doubt pressure was a factor here in causing uterine descent. Case 8 presented generalized muscle weakness, and this followed a back injury and prolonged treatment in a cast. Case 25 developed symptoms after a ruptured appendix and pelvic peritonitis five years before.

In the group without pressure symptoms four out of fourteen had borne children. The low point above the symphysis varied from 3.8 to 8.5 cm. Motion varied from 1.8 to 3.5 cm. Another interesting finding was that in heavy women with increased anteroposterior diameter of the pelvis, the uterus tends to be higher. However, this may be mainly apparent due to the increased angle at the pubis. Cases 3 and 4 are interesting in that they are studies of the same patient before and after an extensive repair operation.

CONCLUSION

1. Uterine position and mobility may be accurately measured by the technic described.
2. A low point less than 3.5 cm. together with mobility greater than 4 cm. indicates uterine relaxation of sufficient degree to be capable of causing symptoms

SUMMARY

A method for measuring longitudinal motion of the uterus is presented and the results in twenty-five cases are tabulated. It is admitted that the number is small but the findings have been consistent. Cases studied while developing the technic now used and also cases studied after this series was completed are in accord with these findings. The average mobility in the group without symptoms was 2.6 cm. and the average low above the symphysis was 5.5 cm. In the group with symptoms the average mobility was 5 cm. and the low point above the symphysis 1.2 cm.

In cases presenting borderline measurements some allowance must be made for the varying thresholds of discomfort in different women. Additional studies may result in some slight modification of the figures given, but it is believed that the given method will provide a simple and accurate objective method of determining the existence and extent of abnormal uterine relaxation.

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TOTAL HYSTERECTOMY

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THE advance of surgical pelvic technic in abdominal hysterectomies has changed the ratio of subtotal to total operations considerably in recent years. In former times subtotal hysterectomy was generally chosen for all benign conditions necessitating an operation, and the total form of surgical treatment was applied exclusively in malignant cases. Complete hysterectomy is performed also for benign disturbances of the uterus, and is gaining lately more and more ground in the treatment of benign conditions of the uterus. The pioneer work was done in large institutions as University, State and County hospitals, where diagnosis indicating operation was under direction of a closed staff utilizing strict principles. In the larger private institutions, where a great number of surgeons do their work according to their own ideas and principles, differentiating substantially from each other, the switch toward total hysterectomy has not reached the right acceptance which it should have.

Nelson and Weisberg in a collected series of cases from the literature combined with their own series summing up 14,591 hysterectomies in all, have reported the ratio of total to subtotal operations as approximately 1:2. This ratio is to be considered recommendable. But in private hospitals the ratio is till 1:4, 1:5 and even 1:6. A ratio in which total hysterectomy is performed more frequently than subtotal, with excellent end results, is reported by Harris and by Masson. The attitude toward total hysterectomy amongst various authors varies still to a great extent as can be seen in Table I collected from the recent literature.

The difference in the mortality rate between one form and the other is almost

negligible, as evident from this table and other reports, but only as long as the operation is performed by an expert hand. The untrained and unexperienced will, of

TABLE I
ABDOMINAL HYSTERECTOMIES

Authors	Abdominal Hysterectomies	Subtotal	Mortality, Per Cent	Total	Mortality, Per Cent
Nelson and Weisberg...	14,591	9,606	3	4,985	3.56
Tytone	453	316	1.9	137	2.2
Harris	1,145	314	0.6	831	0.6
Masson	2,542	766	0.9	1,776	1.2
Phillips and Sears	173	141	1.41	32	0

course, have a considerably higher mortality in total hysterectomies. Nelson and Weisberg observed that the greater the number of total hysterectomies done in any one series, the lower the mortality. In other words skill is the most important factor in the performance of total hysterectomy.

TABLE II

	Number and Per Cent	Average Age in Years	Morbidity (Days in Hospital)	Mortality, Per Cent
Subtotal	141 (73.82)	38.0	13.1	1.41
Total	32 (16.75)	41.7	12.5	0
Vaginal	18 (9.43)	56.6	13.2	0
Summary	191	40.6	13.1	1.05

In our own series of 191 consecutive hysterectomies performed by different surgeons of the active and courtesy staff at St. Joseph's Infirmary, Houston, we had as Table II shows, 141 subtotal (73.82 per cent), thirty-two total (16.75 per cent) and eighteen vaginal (9.43 per cent) hysterectomies. Without any doubt, the number of total hysterectomies is far below the desirable percentage. But St. Joseph's Infirmary is a foremost private institution, where the indication of one type of opera-

tion or the other is determined individually by every surgeon without commonly outlined principles and with a widely varying background as far as training is concerned.

The average age for all hysterectomies was 40.6 years, for subtotal 38.0, for total 41.7 and for vaginal 56.6 years. The stay in the hospital until discharge was on an average of 13.1 days. There was no marked difference of morbidity between one form and the other; the morbidity in total hysterectomies was even slightly lower. However, it must be mentioned that such an estimation of morbidity is incorrect, as the difference of the financial status of different patients changes not inconsiderably the surgeon's advice, at least as to the minimum stay in the hospital. Out of 191 operations we had two deaths (1.05 per cent), both after subtotal hysterectomy which brought the mortality of the latter up to 1.41 per cent. The thirty-two total and eighteen vaginal hysterectomies were without fatality.

The attitude toward total and subtotal hysterectomy is still in many points controversial. Many physicians are hesitating to perform a complete hysterectomy because of higher risk, increased shock, higher mortality and higher morbidity, as they claim. But statistics of competent surgeons eliminate these fears, because they show clearly that the morbidity in total hysterectomies is not increased, often decreased, and that the end results are by far better.

If the only purpose of total hysterectomy would be to avoid the possibility of later developing cancer in the stump, as advocated by Jones, the utilization of this operation would be greatly limited, because the incidence of cancer in the stump after subtotal hysterectomy in benign cases is only about 1 to 2 per cent. But we all see patients coming back after subtotal hysterectomy stating the operation gave them only temporary or partial improvement. They complain of arthritic and myositic disturbances, and upon examination we find a well developed cervicitis with leukor-

rhea, which eventually makes a later surgical intervention necessary. Many of these patients change their doctor because they think the first operation was not successful, therefore making it an impossibility to follow up the postoperative results. If a perfect follow-up after subtotal hysterectomy were possible, we are inclined to believe that the incidence of unsatisfactory end results would be much greater.

Often surgeons will not perform a total hysterectomy, because they believe in opening the vagina the danger of infection is increased. We agree with Masson, who states that by applying a meticulous technic including surgical preparation of the vagina the danger of infection is less, because "in subtotal hysterectomy the cervical glands are cut across and often transversed by sutures," thus forming a focus of infection if the cervix was previously inflamed. Also cauterization and conization of the cervix cannot prevent infection as "those procedures leave a sloughing region continuous with the operative field and peritoneum." Tyrone's opinion in regard to this is as follows: "We are now performing the complete operation more often, not only because of the danger of malignancy in the remaining stump, but because a diseased cervix produces definite and annoying symptoms, whether the uterus is in or out of the patient." We, ourselves, might add that we do not know what purpose a cervix serves without the body, especially in women near or at menopause. Richardson reported that in follow-up examinations of women who have borne one child or more, unsatisfactory conditions of the cervix or the lower birth canal were found in 50 to 75 per cent. Why then preserve a cervix, unless for some important reason?

The objection that following total hysterectomy, shortening of the vagina, diminished secretion of the vaginal mucosa, and prolapse of the vaginal vault—all causes of dyspareunia—do not infrequently occur, is not tenable if the proper technic is employed. Experienced operators, who

did total hysterectomies on a large scale deny these occurrences so well as injuries to ureters, bladder and bowels; the latter occur in unexperienced hands, also in subtotal operations. Furthermore, if the surgeon possesses the necessary skill, the slightly greater technical difficulty of the total operation should be no hindrance to the performer. Only in very obese women and in patients who have an unusually deep pelvis do we encounter some difficulties.

Also the time factor is not a sufficient argument to reject complete hysterectomy, because the duration of the operation is usually estimated to be prolonged from three to ten minutes (three more minutes according to Nelson and Weisberg; five to seven more minutes, according to Tyrone).

Therefore, we would advise total hysterectomy in the following cases: (1) In women who had one or more children by vaginal delivery, requiring hysterectomy for conditions of the corpus uteri; (2) in women near or at the menopause with uterine pathology requiring hysterectomy; (3) in all cases necessitating operation for conditions of the uterine body, in which the cervix is also diseased: (a) lacerations, (b) inflammation (cervicitis), (c) benign cervical tumors (polyps, cysts, etc.); (4) in all malignant cases.

For the advisability of subtotal hysterectomy we like to quote Richardson who considers the following cases as suitable for this operation: (1) Women requiring hysterectomy for benign conditions, who possess perfectly normal cervixes (mostly young women and nullipara); (2) instances in which the operative hazard compels the execution of conservative surgery; (3) cases in which for good and sufficient reasons it is of paramount importance to preserve menstrual function; (4) most cases requiring hysterectomy during pregnancy.

A word might be said about the advices. Usually in performing a total hysterectomy we also remove both tubes. In that way the toilet and peritonization are greatly facilitated. There is less likelihood of pelvic inflammation; the blood supply to the

ovary is improved since there is not the increased strain of nourishing the tube. However, we try by all means to preserve one or at least a part of the ovary corresponding to the pathological involvement of the ovaries whether the woman has passed menopause or not, as long as complete atrophy of the ovaries has not taken place. Caution should be observed not to fix the ovary to the vaginal vault because this often causes dyspareunia, but instead to bury it between the folds of the broad ligament.

We usually make use of Masson's technic for complete hysterectomy, and this with good results. Here we can only briefly emphasize the most important steps of the operation. The operation is performed in the same way as for subtotal hysterectomy, only that in addition the bladder is freed way down from the cervix and the vaginal vault. The cervix should be enucleated from the vaginal vault. As soon as the vagina is opened and the cervix enucleated, we insert an iodine sponge which is removed after the operation. The vaginal vault is closed with a continuous mattress suture in two rows rolling the eut edges of the mucosa into the vaginal canal. Then the peritoneum and the uterosacral ligaments are brought upward and placed over the vaginal vault. After that the round ligaments are approximated and overlapped and secured to the vaginal vault, to the tissues in the base of the broad ligament, to the stumps of the uterine vessels and to the uterosacral ligaments. Peritonization of the raw surfaces completes the operation. No drains are used. Employing this technic, an injury to the ureters, bladder and bowels as well as shortening of the vagina can be relatively easily avoided.

Concluding, we believe that with proper technic the risk of total hysterectomy is not much greater than in subtotal hysterectomy. The satisfactory end results should make this operation much more popular than it actually is at the present time.

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CONSTANT rales at the lung bases are never found in the normal pregnant woman. When they appear in a Group 1 cardiac, they constitute the most reliable and earliest sign of heart failure.

From—"The Heart in Pregnancy and the Childbearing Age"—by Burton E. Hamilton and K. Jefferson Thomson (Little, Brown and Co.).

PRURITUS ANI

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THE tattoo treatment for pruritus ani has recently come into prominence. It offers definite promise as a distinct advance in the treatment of this often baffling syndrome. Pruritus ani may be very pernicious, and we have all seen cases in which conservative methods of therapy have yielded only very transient benefits. The multiplicity of suggested treatments bears adequate witness to the fact that no therapy is very successful. Ointments, anesthetic powders, injection of water-soluble or oil-soluble anesthetics, alcohol injections and electric treatments have all been suggested and employed with varying degrees of success.

When conservative measures have failed, and when no rectal or anal pathology other than the postpruritic skin changes are present, tattoo therapy is indicated. If hemorrhoids, internal or external, fissure, fistula, proctitis or other pathology is present, these conditions must first be brought under control. If the pruritis still persists, we may proceed with tattooing. Obviously, sigmoidoscopy must be negative and the urine free from sugar.

Because of the uniformly poor results that I have observed as a consequence of haphazard, unskilled tattoo technique, this paper will limit itself to a discussion of proper tattoo technique.

The instrument employed has a speed of about 3,000 vibrations per minute. The needle bar holds eight to ten needles. This number is arbitrarily chosen because it offers a broad, easily handled working tattoo surface.

A lesser or a greater number of needles might be employed. The needles are very fine, are set in a single row and are adjusted to penetrate to a 2 mm. depth. To eliminate vibration, and to permit better instrument

control, the operator may maintain his elbow close to his body. The instrument shaft is held between the thumb, index and middle fingers, curving the ring and little fingers outward upon the patient's skin. This position of the latter two fingers serves to further steady the instrument and to aid in guiding its direction and motion.

The needles must form an oblique angle of about 45 degrees with the skin. They will then penetrate the skin obliquely and will deposit the dye particles at the proper depth. The motion of the instrument may be back and forth, or rotary in small circle areas. The dye penetrates, however, only with the stroke toward the direction of the needle points. The machine may be lifted off the skin in a series of brushing strokes, starting from various points on the circumference of the perianal area and proceeding radially inward toward the anus, maintaining the 45 degree angle, and moving toward the needle points with each stroke. This requires greater effort than the back and forth motion, because of the added lifting of the instrument. I prefer the back and forth motion for broad sweeps, and the small-circle rotary technique for touching up smaller areas.

It is exceedingly important to keep the skin under tension while tattooing. Every perianal fold must be straightened and the entire perianal region must be carefully tattooed. If the skin is not held under tension, the tattoo will be ineffective. Skin tension may be maintained by the operator's left hand or by an assistant.

Cinnabar, (mercuric sulfide) is the dye employed. It is a red powder. A few cc. of sterile distilled water, alcohol, solution of merthiolate or procaine are added to a small quantity of the dye, and a heavy solution is made. Water alone is adequate.

The other solutions are suggested for added antiseptic or anesthetic effect. The needle points are dipped into the dye mixture from time to time while tattooing.

caine, 1.0 per cent phenol and 10.0 per cent benzyl alcohol. Anucaine, containing in each 5 cc., procaine base 0.05 Gm., butesin, (n-butyl-p-amino-benzoate, Abbott) 0.20



FIG. 1. The tattoo instrument shaft is held between thumb, index and middle fingers, the ring and little fingers being spread-eagled upon the patient. The instrument is held at a forty-five degree angle.

The patient is prepared by shaving the perianal area. Tincture of green soap may be employed for this operation. Antisepsis consists of iodine or tincture of metaphen followed by alcohol. The area of preparation, as well as the section to be tattooed, should extend well beyond the pruritic zone.

Anesthesia may be local infiltration, sacral block, or spinal. My personal belief is that this is an office procedure, and my preference, therefore, is local infiltration anesthesia. Oil-soluble anesthetics have been injected under the skin of the perianal region as a method of therapy for pruritus ani. I would suggest the use of an oil-soluble anesthetic as the pretattoo anesthesia. This would also obviate post-tattoo discomfort. Various formulas have been suggested for oil-soluble anesthetics.

Gabriel's modified solution is oil of sweet almonds containing 0.5 per cent nuper-

Gm., benzyl alcohol 0.25 Gm., and sweet almond oil q.s. 5.00 Gm., is recommended. Morgan's solution is peach-kernel oil containing 1.5 per cent procaine, 6.0 per cent butesin, and 5.0 per cent benzyl alcohol. Still another formula contains eucupin base 0.2 per cent, ethylaminobenzoate 3.0 per cent, benzyl alcohol 5.0 per cent and oil of sweet almond q.s. Eucupin is isoamyl-hydrocupreine, an alkaloid synthesized from quinine.

TECHNIC

Because of the importance of proper infiltration of the oil soluble anesthetics, this technic will be briefly outlined. Any syringe may be employed, but a 10 cc. Luer-Lok type, with a twenty gauge two inch needle is probably most satisfactory. Warm the anesthetic solution before drawing into the syringe. A primary procaine

wheel may be raised at the sites through which the larger oil bearing needle is to be inserted, but this is not essential. The entire

sponged in order not to obscure the field of operation.

The technic described should be carefully

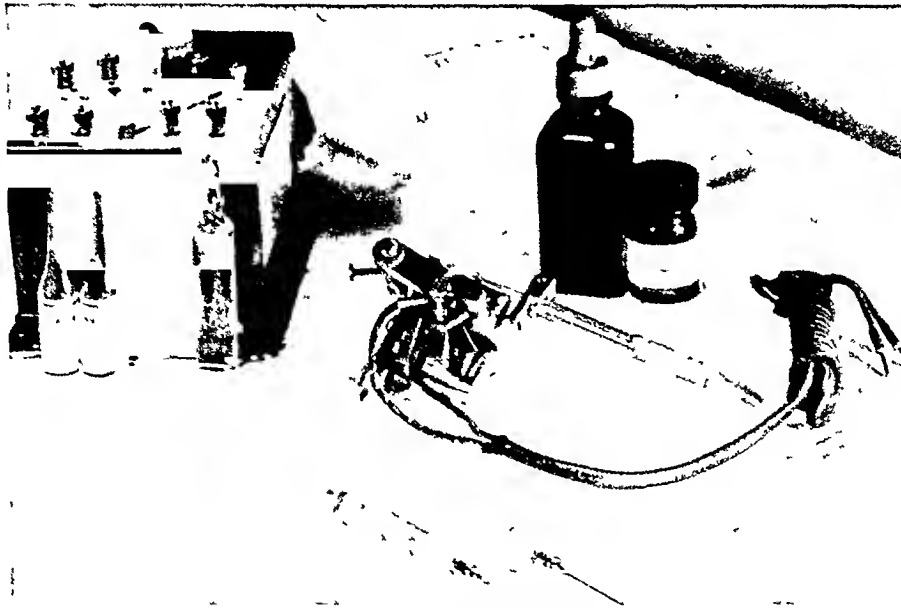


FIG. 2. Tattoo preparation: the instrument and transformer. In front of the transformer are two ampoules of anucaine and a large ampoule of triple distilled water to mix with the dye. A bottle of antiseptic solution and the two syringes are also shown. The smaller syringe is for procaine, the larger for the anucaine.

perianal area must be injected if a complete tattoo is to be done at one treatment. It may be preferable, in some cases, to inject and tattoo only half the circumference area of the pruritic zone at each of two treatments. Infiltration is subcutaneous, fan-wise in distribution, slowly and evenly injected, with careful avoidance of pooling. Injections may be started from anterior, posterior and lateral points, injecting while withdrawing the needle. Twenty to 30 cc. of solution will be used for complete perianal infiltration. Massage of the injected area will aid in preventing pooling.

When anesthesia is complete the skin is coated with an ointment. Nupercainal, carbolated vaseline, or lanolin may be employed for this purpose. The ointment serves the purpose of holding the dye particles on the skin area to be tattooed. Tattooing may then proceed. The cinnabar dye particles are heavier than the usual tattoo pigments and are, therefore, more difficult to drive into the skin. Thus, a certain amount of bleeding will result. This should be frequently and continuously

followed. Skipped areas will result from improper management of the procedure. Failure to hold the needles at the proper angle will produce ulcerations and sloughs. Gauge the depth of the needles by the feel of the instrument in motion and by the appearance of the tattoo. There should be no sticking or jarring, and the tattoo should be smooth and uniform. Proper evaluation of this method of therapy can be made only by those who have acquired a skillful tattoo technic.

SUMMARY

Tattoo therapy is indicated in cases of pernicious pruritus ani when more conservative measures have failed and when no rectal or anal pathology other than the post-pruritic skin changes are present.

Anesthesia for this office procedure may be local infiltration, preferably with an oil-soluble anesthetic. Anesthetic formulas and the technic of infiltration anesthesia are described in detail. Twenty to 30 cc. of solution, carefully injected to prevent pooling, is usually adequate.

After anesthesia, the perianal area is coated with an ointment, such as lanolin, nupercainal or carbolated vaseline, to hold the dye particles during tattooing. The dye employed is cinnabar (mercuric sulfide), making a heavy suspension in water, alcohol, solution of merthiolate or procaine. The tattoo instrument has a speed of about 3,000 vibrations per minute and employs

eight to ten needles. The needles are dipped into the dye mixture from time to time while tattooing, and are held against the perianal skin at a 45 degree angle. The skin must be kept under tension, while the instrument is used with a back and forth or rotary motion.

The resulting tattoo should be smooth and uniform.



“ESSENTIAL” hypertension may depend upon atheromatous narrowing of the orifices of the main renal arteries, or by kinking, or by pressure upon these vessels by new growths.

From—“Convalescent Care”—(New York Academy of Medicine).

BENIGN PAPILLOMA OF THE RENAL PELVIS*

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PRIMARY tumors of the renal pelvis are of rare occurrence. The majority of them are papillomatous, far outnumbering the squamous cell type. While it is usually believed that the true papilloma is the most frequently found, nevertheless series of cases are reported in which the malignant tumors are much more numerous. Hugh Young agrees with this, stating "benign neoplasms of the renal pelvis are exceptionally infrequent, malignant changes being usually found upon close and careful pathological examination." It is this rarity that prompts us to report this case, the only one in the records of the Long Island College Hospital as far as we are able to ascertain by diligent search.

We quote from a paper published by us in the *American Journal of Surgery* in 1937 on primary epithelial tumors of the renal pelvis: "The benign papilloma usually arises in the renal pelvis and metastasizes to the ureter and bladder by direct extension and implantation. These tumors are as a rule multiple and may be extremely numerous, covering the entire mucosa with fine vegetations. Occasionally there is seen one large tumor with several small polyps scattered over the pelvis and calyces. The tumors are villous or wart-like, attached by a narrow pedicle and expand in a fan-like shape. Their greater vascularity is a source of hemorrhage which is the chief symptom. Incrustations with salts and calculi are frequently seen. Various grades of hydronephrosis often result from partial occlusion, chiefly by ureteral transplants. The microscopic structure is typical and consists of elongated blood vessels covered by multiple layers of transitional epithelium. The tumor cells are cubical, cylindrical or elongated and spindle-shaped, but

the arrangement is orderly and the growth is confined to the mucous membrane. Round cell infiltration is found at the base of the tumor. The course of these tumors is usually benign but they may become malignant by invasion of the submucous layers, so that they always should be considered potentially malignant. Recurrences after removal or from implantation in the wound, have occurred in a malignant form."

This disease is one of adult life; most cases occur in individuals between the ages of forty and seventy years. Its origin is still a matter of conjecture, yet one cannot lose sight of the prominent part played by chronic irritation and infection over a long period of time. The importance of congenital abnormalities in the production of these growths is problematical.

The symptomatology of pelvic papillomas is that of any renal neoplasm. In their order of frequency of occurrence, and chronologically the symptoms are hematuria, pain and tumor mass. Hematuria occurs in seventy out of ninety cases and is often intermittent and painless, but occasionally may be colicky due to the passage of clots. The pain may be a dull, persistent ache in the renal area or a true colic and may result from ureteral obstruction caused by blood clots or ureteral tumor transplant. The tumor mass is most often a hydronephrotic enlargement of the kidney.

For the diagnosis of renal pelvic neoplasm, one must depend largely upon cystoscopic and pyelographic findings. A picture of a more or less dilated pelvis within which one visualizes a filling defect is fairly characteristic. The presence of a tumor transplant about the ureteral orifice or the adjacent bladder wall asso-

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ciated with these findings points strongly to a neoplasm of the pelvis. However, considering everything the diagnosis is made



FIG. 1. Pyelogram showing characteristic deformity.

with difficulty preoperatively. One must consider in the differential diagnosis defects due to incomplete filling of the pelvis with pyelographic medium and defects due to

plasm to progress by extension along the mucous membrane of the ureter and into the bladder, along with their high incidence of recurrence in malignant form, makes it imperative that the surgery be of a radical nature. Therefore, complete nephro-ureterectomy including the resection of a portion of the bladder wall immediately adjacent to and surrounding the isolateral ureteral orifice is recommended. Occasionally where indicated, because of the patient's poor condition, it may be advisable to perform the operation in two stages, the nephrectomy first and the ureterectomy later. Simple nephrectomy is justifiable only as a palliative measure. Roentgentherapy offers us very little hope.

CASE REPORT

The following is the report of a sixty-three year old Czechoslovakian machinist who was admitted to the urological service of the Long Island College Hospital on August 16, 1939. He had never had any urinary symptoms prior to the evening before admission when he noted a moderate amount of blood mixed with his urine. That night he voided three more times, very unusual for him, and each time the urine was pink in color. He had no pain what-



FIG. 2. Low power photomicrograph of the papillomatous growth.

blood clot. It would also be difficult to exclude a parenchymal tumor that had secondarily invaded the pelvis.

As regards the treatment of tumors of the renal pelvis, whatever the nature of the growth, surgery is indicated. The well known tendency of the papillomatous neo-

soever, although he did have slight soreness in the left flank.

The past history included malaria in 1907 and psoriasis in 1932. Venereal disease was denied by name and symptoms. He had a right hydrocele for years. He admitted drinking at least a quart of whiskey each week for years.

Physical examination revealed the patient to be a stolid, well developed flabby looking, co-operative white male, who looked his stated

elective ureterectomy. His general condition had, in the mean time, improved considerably. Cystoscopy now revealed a normal bladder.



FIG. 3. Gross specimen, illustrating tumor in the kidney pelvis.

age. The only positive findings were many carious teeth, a left nontender, palpable kidney which did not feel enlarged and a large right hydrocele of the tunica vaginalis.

The bladder urine was bloody but not all blood. The capacity was 10 ounces. The mucose, trigone and bladder neck were normal. Urethroscopy revealed no abnormal findings. Number 6 F catheters were introduced without obstruction to 25 cm. The left kidney urine was hazy amber and contained very many red blood cells. Phenolsulfonphthalein excretions were normal. Urine cultures produced no growth. Retrograde pyelography revealed a filling defect in the pelvis of the left kidney producing a smooth compression of the left pelvis and calyces. The left ureter was moderately dilated in its entire extent. The right side was normal. Confirmatory intravenous urography revealed the same filling defect.

A tentative diagnosis of papillary tumor of the left renal pelvis was made and on August 24 a nephrectomy and partial ureterectomy were performed. Further operative procedure was deemed inadvisable at this time because of the patient's poor general condition. Convalescence was rapid and uneventful. The wound healed by primary intention and the patient was discharged to the clinic on the thirteenth postoperative day. Three months later the patient was readmitted to the hospital for an

Most interesting of all was the apparent complete occlusion of the left ureteral stump. Because of this and since there was no evidence of recurrence, it was decided not to perform this surgical procedure. The patient since has been very cooperative and has revisited the Out-patient Department on many occasions. As far as we are able to tell he is entirely well.

The kidney measured 12 by 6 by 4.5 cm. The capsule stripped with ease. Fetal lobulations are present. The pelvis showed only a minimal amount of dilatation. Liquid purulent material was present and in the widest portion of the pelvis, almost directly in the center, there was a filamentous, friable mass measuring 2 by 2 by 1 cm. Its base was attached to one side of the pelvis while the apex partially obstructed the ureter. The ureter was markedly thickened.

Microscopically, the section through the tumor mass and pelvic membrane consisted of multiple axes of connective tissue covered by several layers of transitional epithelium which was uniform in size, shape and staining characteristics. There was no infiltration, bizarre-shaped cells or mitotic figures. The pelvic membrane was somewhat thickened and fibrosed and there was a minimal amount of round cell infiltration.

Diagnosis: Papilloma of the renal pelvis.

CONCLUSION

A case of papilloma of the renal pelvis is herein reported. The only symptom noted was one episode of silent hematuria. Nephrectomy and partial ureterectomy have apparently produced a satisfactory result although it is still too early to determine the subsequent events in this case.

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A MAJOR revolution regarding many theories in the virus field is under way, and it is believed that the upheaval will produce advances in general knowledge as well as an improvement in man's physical and economic well-being.

From—"The March of Medicine"—New York Academy of Medicine (Columbia University Press).

PREVENTION OF ACUTE URINARY RETENTION FOLLOWING ANORECTAL AND PERINEAL SURGICAL PROCEDURES*

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ACUTE urinary retention is a frequent and troublesome complication following anorectal and perineal operative procedures. It is particularly so in male patients. Acute urinary retention severe enough to require catheter relief occurred in fifty-seven of a consecutive series of one hundred operative cases, sixty-eight of which were anorectal and thirty-two perineal urological procedures. Catheterization was resorted to only after failure of conservative methods to stimulate spontaneous micturition such as running water from a tap, perineal heat, standing out of bed, etc.

Inasmuch as the urinary bladder, anus and perineum are closely associated through the interrelationship of their motor and sensory nerve supply (the lumbosacral plexus), bladder dysfunction may result following operation in the anoperineal region. Powerful afferent stimuli originating in the pain sensory fibers of the operative wound probably cause aberrations in efferent motor stimuli which, reaching the bladder, results in the dysfunction manifested as retention. Briefly considered, the actual mechanism of retention consists primarily of atony of the involuntary muscle of the bladder wall (detrusor muscle) and possible spasm of the voluntary musculature surrounding the deep urethra (external sphincter). Increase in the tone of the detrusor muscle will cause contraction of bladder wall and increase in intravesical urinary tension. When the intravesical tension becomes sufficiently high, resistance of the internal and external sphincters are overcome, spontaneous micturition

ensuing throughout the period of continued vesical contraction.

Woodruff and Te Linde recently reported a method of successful prophylaxis of postoperative retention in a large series of gynecological patients. After operation a 0.5 per cent aqueous mercurochrome solution was instilled into the bladder per catheter with the result that 93.4 per cent of their patients voided spontaneously after an average of five and one-half hours. In a control series (no mercurochrome) postoperative catheterization was necessary in 51 per cent.

The rationale of this treatment depends on stimulation of the sensory mechanism of the bladder wall by the chemical, mercurochrome. This stimulation acting as a counterirritant prevents atony and stimulates contraction of the detrusor muscle in the bladder, intravesical tension increases and spontaneous micturition results.

The striking results of Woodruff and Te Linde induced us to institute this method on our proctological and urological services at Sea View Hospital. Consequently, on conclusion of the operation and before the patient is removed from the table, 30 cc. of a 0.5 per cent aqueous solution of mercurochrome is instilled into the bladder per catheter. Precautions against the possibility of mistakes must be taken by having the 0.5 per cent aqueous mercurochrome specially labeled in a specially shaped bottle and poured into the measuring glass under the direction of the operator. An alcoholic solution of mercurochrome was mistakenly utilized in one early case resulting in a severe cystitis.

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One hundred forty patients were treated postoperatively with mereurochrome instillation as described. Of one hundred patients with anorectal operative procedures for perianal and ischiorectal abscesses; fistulectomies and hemorrhoidectomies, only one developed postoperative retention and required catheterization. Forty patients had orchidectomies, epididymectomies and hydrocelectomies. All voided spontaneously. Caudal block anesthesia with 2 per cent procaine was utilized in most cases. Sea View Hospital is devoted solely to the care of tuberculosis. Operative resections were extensive as lesions consisted mostly of perianal and perineal urological tuberculosis.

SUMMARY

One hundred forty patients underwent anorectal or perineal urological operative procedures. On completion of operation, 30 cc. of a 0.5 per cent aqueous solution of mereurochrome was instilled into the urinary bladder. Acute urinary retention requiring catheterization occurred in only one case (0.8 per cent). In a previous series of one hundred similarly operated cases in which no mereurochrome was used, acute urinary retention requiring catheterization occurred in fifty-seven.

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Case Reports

BULLET WOUND OF LEFT CARDIAC AURICLE WITH SUTURE AND RECOVERY*

A REVIEW OF THE LITERATURE

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WE present a rare case of gunshot wound of the heart involving the left auricle. An exhaustive search of the literature fails to reveal an instance of bullet wound of the left auricle with operation and recovery. The application of surgery to heart wounds has been, in the main, limited to knife or ice pick trauma cases. Because of the proximity of the left auricle to the pulmonary artery, aorta and root of the lung, bullet wounds in this region are invariably fatal, death being almost instantaneous. Of further interest in this case are the serial electrocardiographs depicting the pathological changes involved.

REVIEW OF THE LITERATURE

Incidence and Types. Heart wounds are uncommon. The trauma is usually caused by a knife or ice pick. In Elkin's²² series of twenty-two cases, fifteen were knife wounds and seven ice pick in origin. He states that, "no cases with gunshot wounds of the heart have been treated, for the reason that they usually die from hemorrhage before reaching the hospital." A bullet usually causes two wounds: entrance and exit, and

greater destruction. Bigger⁴ and others also report that most patients with penetrating wounds of the heart who are operated upon present stab wounds. On the other hand, an isolated injury to the pericardium, is more rare than an injury to the heart. According to Ginzburg and Sarkisov,¹² the ratio is 1:10. Isolated pericardial injuries are less apt to occur for the following reasons (Kosmin¹³): cardiac activity, point of entrance, character of the instrument (bullet wounds not likely), direction, and the degree of penetration. Most cases of penetrating heart wounds are complicated by pleural injury, hemothorax, pneumothorax or combinations of all. For the purpose of classification of heart wounds, Bigger³ suggests in effect the following: (1) Pericardial injury alone, or pericardium plus heart wall without penetration into heart chambers, or divisions of important coronary vessels. These are difficult to diagnose and usually do well without operation. (2) Severe injuries—death before surgery can be performed—gunshot, etc. (3) Penetration into heart chambers or coronary artery injury—diagnosis not difficult because tamponade is usually present; if not, as in a case in

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which the opening between the pleural and pericardial cavities is large enough to allow for leakage of blood, absence of tamponade may make diagnosis difficult. Nevertheless, surgery is indicated if injury is in the cardiac region and there are signs of intrathoracic hemorrhage. Statistics approximate the location of heart wounds which come to operation as 55 per cent in the right ventricle, 35 per cent in the left ventricle, and 10 per cent varied or combined.

Mortality and Morbidity. The mortality is dependent upon the type and location of the wound. Most statistics refer to stab wounds. The lowest mortality for an individual collection of cases may be credited to Bigger¹—twenty-five cases with a mortality rate of 36 per cent, of which only two were bullet wounds (both in the ventricle, with one recovery). His mortality ranged from 29.5 per cent for right ventricle wounds to 100 per cent for pulmonary artery plus ventricular injury. In response to a questionnaire the same author noted a mortality of approximately 50 per cent in 141 cases. Nissen²¹ also found the same mortality from collected statistics. Elkin's²² formidable list of twenty-two cases likewise presented a 50 per cent mortality. Mayer²⁷ makes the observation that, "Cases reported treated conservatively in previous years show that only 10 per cent to 15 per cent recovered." Elkin²³ finds that the prognosis is 80 per cent recoveries in right ventricle wounds (easier to suture, etc.), while the high mortality in auricular injury can be attributed to the difficulties involved in the approach and suture of the thin-walled auricle. Because death may occur from hemorrhage, tamponade or both, early operation is important. Bigger³ is also of the opinion that, "The prognosis depends not only on the type of injury, but also on the promptness with which surgical aid is given." The majority of Bigger's patients who recovered were operated upon within three hours of the time of injury. In one case, operation was successful six to seven hours after a knife wound.

Without exception, it is agreed that the

chief cause of death postoperatively is infection. Elkin²³ notes that in 75 per cent of operations with a fatal outcome, the cause of death is either pneumonia or purulent pericarditis. Bigger³ lists the most frequent postoperative complications: infection, pulmonary infarction and cardiac tamponade. On considering the preventable causes of death, Singleton¹⁹ mentions in the order of their importance: hemorrhage, tamponade and infection. Contrary to expectations, pericardial adhesions do not seem to cause any difficulty. According to Nissen's²¹ collected statistics, pericardial effusion resulted in 40 per cent of all cases in spite of the fact that his observations failed to reveal even one instance in which the pericardium had closed spontaneously. Peculiarly enough, the late results showed that the functional disturbances when present, were nearly always respiratory instead of cardiac. This point has been emphasized by LeFort and Decoulx who noted the results in fifty-five cases seen after more than twenty years. They state that "Even in cases in which the lesion involved the myocardium, pericardium, large vessels or the cardiac nervous plexus, the circulatory system was surprisingly little affected . . . and that the electrocardiograms (16 cases) were invariably normal or nearly so 20 years after the original trauma." Hesse⁷ reports a case of bullet wound of the left ventricle with successful suture, in which after twenty-six years, there was no cardiac difficulty, but dyspnea was present on marked exertion.

Mechanism. Under normal conditions, the intrapericardial pressure is below atmospheric pressure and it is probable that there is a negative pressure in the venae cavae within the thorax (Elkin²³). Furthermore, an increase in the intrapericardial pressure necessitates a rise in the venous and fall in the arterial pressures. Progression in this direction leads to circulatory collapse. Bigger¹ finds that the patient will develop a temporary circulatory adjustment with general improvement following a favorable response to the origi-

nal circulatory collapse. This response is summarized by Elkin: "an increasing intrapericardial pressure must be overcome by an ever increasing venous pressure if the circulation is to be maintained." Following the injury, the heart bleeds into the pericardial or pleural cavities and externally. Pericardial distention occurs when 100 to 200 cc. of blood accumulates. This is the beginning of a vicious cycle. As the intrapericardial pressure increases the venae cavae become unable to pour sufficient blood into the heart. Furthermore, the emptying capacity of the heart also decreases. Finally, progressive cerebral anemia results in death. During the present Sino-Japanese war, Ransom¹⁷ observed 150 cases of chest wounds. He found that the presence of pneumothorax was most significant in its mechanism on the thoracic contents. Because of the effect of mediastinal flutter on the great veins by producing intermittent pressure on the venae cavae, cardiac difficulty was further aggravated in addition to that due to the heart wound itself. Tamponade may be absent where there is an opening between the pericardial and pleural cavities. The size of the heart wound and the rate of blood flow also determine the rapidity with which death may ensue from hemorrhage. Another condition which may lead to a fatal outcome is tension pneumothorax. Here, the pleural pressure advances towards a positive value. Therefore, it becomes imperative that the pleural pressure be reduced. Collapse of the lung will be in direct proportion to the degree of hemothorax, and hemorrhage will tend to stop when the pressure of fluid (blood) reaches a corresponding level (with the exception of injuries near the hilus). The advisability of aspiration of blood in instances other than in those in which pressure symptoms are present, is controversial. However, when aspiration becomes necessary, replacement with air is usually of value. Air not only serves to allay bleeding from the lung but also is beneficial because of its "cushion-like" effect and more equalized pressure, thereby

permitting healing. Some surgeons believe that complete aspiration with air replacement should be routine because of the danger of infection, autogenous or otherwise, in which fluid serves as a good medium for bacterial growth.

Diagnosis. A precise history is valuable in making a diagnosis of heart injury but in most instances is not obtainable. Elkin²⁴ stresses that a "—history of a symptomless interval, similar to that seen in intracranial hemorrhage, during the time the pericardium fills with blood, is the most important point in the history." During the present Sino-Japanese and Spanish Civil Wars, Sellors¹⁶ has observed one syndrome which is common to all chest wounds, that is, shock and dyspnea. The presence of bleeding is shown by an increasing pulse rate. The usual sign of air-hunger present in hemorrhage, may be unnoticed because breathing is difficult. Vakhrameev¹⁸ observed a pulse irregularity in four out of seven cases. Without tamponade, the diagnosis of heart injury may be difficult. The signs of tamponade are, a low or unobtainable blood pressure, weak, rapid or absent radial pulse, distant and muffled heart sounds, increased venous pressure with distended veins in the neck, marked dyspnea, pallor, cyanosis and fluoroscopic examination with absent or markedly decreased cardiac pulsation.

Most authors agree that fluoroscopy is of great diagnostic value. Constantini¹⁵ claims priority for the use of fluoroscopy in determining the presence of hemopericardium—immobility of the heart in addition to enlargement. The x-ray is usually of little aid unless the hemopericardium is marked and pleural fluid is absent—a rare combination. Furthermore, according to Hegner, the x-ray is of value only if taken in the erect position; this is not permissible during the first twenty-four hours. Kosmin¹³ points out that an isolated pericardial wound may be asymptomatic because pericardial injury alone does not cause pain and heart activity may not be altered. However, a hemopericardium may occur in the

presence of an isolated injury to the pericardium. If this prevails, differentiation may be difficult. Tamponade is more intense and rapid in heart injuries. Bigger was able to confirm the diagnosis of tamponade in thirteen cases of his series. Ginzburg and Sarkisov¹² list the symptoms of isolated pericardial injury as: hemorrhage from the wound, dyspnea, increased area of cardiac dullness, clear heart sounds and temporary and insignificant symptoms of compression of the heart. Pain depends on the presence of injury to the ribs. Venous pressure, normally ranging between 7.5 and 12.5 cm. of water has been recorded as high as 40 cm. The duration of an elevated pressure prognosticates a fatal issue. Sellors¹⁶ found that in cases of projectile injuries, a small exit wound indicates that no bone has been encountered.

In lung injury, cough may be troublesome. Hemoptysis is variable in degree and when present is a pathognomonic sign of lung injury. This sign is frequently delayed. In a hemopneumothorax, the volume of air and blood are inversely proportionate. Hegner's¹ observations concerning hemopneumothorax are most interesting. He finds that slow bleeding with an associated smaller accumulation of blood, reduces the chances of clotting because the lapse of time allows for fibrin precipitation with tissue and pleural reaction, thereby modifying the blood, and preventing clotting. On the other hand, when marked hemorrhage occurs, there is no time for precipitation and tissue reaction, so that blood coagulation results and absorption follows slowly. This is the reason why the blood obtained from a marked hemorrhage may be used for autotransfusion, i.e., unaltered blood. Aspiration may then serve as a diagnostic test for massive and recurrent bleeding wherein the blood is found to coagulate. Since the initial blood found in a hemothorax is sterile, since absorption allows for early lung re-expansion with the danger of added hemorrhage, and since late hemorrhage may be contaminated and bacterial growth likely to occur in a suit-

able medium, all of this, makes aspiration with immediate replacement by artificial pneumothorax an advisable therapeutic precautionary measure. The continuance of fluid and its accompanying pleural reaction permits for lasting adhesions. This is another argument for complete aspiration with pneumothorax. Partial aspiration as practiced by some, still leaves open the possible complications mentioned above. Schlomka²³ states that, "air does not embarrass to the same degree as fluid, the retractile power of the opposite lung."

Elkin²² makes an emphatic statement when he writes that although death from hemorrhage may occur without tamponade, he has never observed this in any case.

Electrocardiography in the diagnosis of heart wounds has little if any value because, commonly, the tracings are normal for many hours following the trauma or suture. Its value comes later when the degree of infarction or progress in healing is to be ascertained. Koucky and Milles²⁰ collected the tracings from thirteen cases in the literature. These electrocardiographs were of no value in localizing the site of heart injury, and failed to picture ligation of the coronary arteries when this procedure had been performed. They concluded that, "a return to a normal curve apparently occurs ultimately in the vast majority of cases." In Nissen's²¹ four cases, the electrocardiograms returned to normal after ten days. Morris¹⁷ noted a normal tracing three and six weeks postoperatively.

Treatment. In outlining the treatment of heart wounds, Bigger² classifies his cases into 4 types as follows: (1) Those in which there is free communication with the pleura but only slight or moderate hemorrhage—treat conservatively. (2) In those cases in which tamponade is present but improvement is marked (rise in blood pressure, etc.) following venoclysis, adrenaline and morphine, patients are prepared for operation. The pericardium is aspirated through a cannula to lower the intrapericardial pressure. With the cannula left in situ for fifteen to thirty minutes, renewed bleeding

is watched for. The prompt re-appearance of tamponade is an indication for immediate operation, otherwise conservatism is followed. (3) When there is a marked increase of intrapericardial pressure without a satisfactory response to conservative treatment such as a continued low blood pressure, immediate operation is indicated. (4) When there is free communication with the pleura in addition to massive intrapleural hemorrhage, immediate operation plus autotransfusion is indicated. There is a high mortality in these cases.

In general, treatment varies between two extremes. Desjacques and Clert¹⁰ recommend immediate surgical exploration in all open wounds of the chest made by a knife or bullet. Cox²⁹ treated tamponade in his case by repeated aspirations (five) with recovery. Singleton¹⁹ believes that aspiration of the pericardium may be performed for temporary relief, or in preparation for operation in some instances, and in addition may serve as a curative therapeutic measure. Morris¹⁷ and Elkin²² believe that immediate operation is essential when tamponade is ascertained, while in the patient in extremis, it may be a life-saving procedure. He also advises against the use of intravenous fluids because of the danger of increasing an existing tamponade. The application of external heat and the administration of morphine should be instituted in all cases. A propped-up position is usually more comfortable for the patient, i.e., coughing and dyspnea are alleviated and the incidence of atelectasis is decreased. The oxygen tent is another important therapeutic measure. It relieves dyspnea and cyanosis and improves the pulse and blood pressure. While pneumothorax is often beneficial in the control of pulmonary hemorrhage, a tension pneumothorax must be watched for and is easily overcome by releasing air through an aspirating needle connected to a tube led under water in a bottle. Blood transfusion is of greatest importance postoperatively to combat shock and hemorrhage. Watson and Watson⁸ claim to be the first to use autotransfusion

successfully in a case of heart wound. There is no doubt that this is an expedient and practicable measure. Elkin²² recommends an autotransfusion of citrated blood during or immediately after the operation as the case requires. Under discussion in Singleton's¹⁹ paper, Dr. R. L. Rhodes presented two cases in which the blood was aspirated during the operation, filtered and injected into a vein or directly into the ventricle.

The choice of anesthesia varies with the pathology present and the patient's general condition. Elkin²³ prefers nitrous oxide inhalation anesthesia to local anesthesia because positive pressure is needed to inflate the lung if the pleura has been opened either by the wound or during the operation. Furthermore, he believes the difficulties encountered in heart suturing are increased by a struggling patient especially so as commonly occurs after the tamponade has been released. Bigger³ states that, "... if a transpleural approach is to be used, a general anesthetic administered under slightly positive pressure is preferable; but if an extrapleural approach is planned, a local anesthetic is entirely satisfactory." In nearly all of Vakhrameev's cases, the author employed ether anesthesia.

There is a unanimity of opinion on the paramount importance of strict asepsis throughout, since all agree that infection is the most common and dangerous postoperative complication.

Débridement of the knife or bullet wound is a further added precaution against infection. This applies particularly to knife and ice pick wounds.

It has been pointed out that no one method of operative approach is suitable for all cases of heart injury. A commonly used incision is one which forms a flap with its convexity toward the left border of the sternum and includes the interval between the third and fifth ribs. A good exposure with minimum trauma is essential. Whenever possible in those cases in which the pleura has not been injured, an extrapleural approach should be made. Opening

a sound pleura increases shock and adds the danger of infection. Elkin²³ with his extensive experience usually finds that the best approach to the heart is to the left of the sternum, except in those cases in which the entrance of the wound is located on the right side. His incision is planned at all times to allow for enlargement of the operative field. He finds that a long transverse incision extending across the sternum allows for the removal of one or two ribs and where necessary the adjoining cartilages or part of the sternum. There is less danger of injury to the pleura when the rib is cut first and displaced from its periosteal covering followed by removal of the corresponding cartilage. The next step includes division of the internal mammary vessels and triangularis muscle. Lateral displacement of the pleura by gentle gauze and finger dissection is the next important step. The transverse incision is less shocking and less time consuming than the convex flap method previously mentioned. Constantini¹⁵ believes that the best approach is to resect the cartilage closest to the wound which gives pericardial exposure, and then to enlarge the exposure depending upon the need. However, he usually makes a flap with its convexity medially and exposes the cartilages, then resects the left border of the sternum and also the right border of the sternum opposite the fourth intercostal space if necessary. Additional cartilages may be removed as required to enlarge the field. He observes that visibility is chiefly obscured by the left border of the sternum which he always resects so as to be better able to examine the right auricle.

The pericardium which now comes into view will be found bulging and blue if tamponade is present. If the rent in the pericardium is easily found, the opening is enlarged, otherwise it is opened between stay sutures. The contents are aspirated. Wiping is not advisable because with this added trauma, effusion will ensue to a greater degree than usually occurs. Later, the pericardial sac may be flushed with saline. The hemorrhage from the heart

wound must be put under control immediately. This is facilitated by placing the tip of the index finger *on* the wound (Elkin)²³ not *into* the wound because of its friability, and a suture of black silk is passed under the finger. This suture serves for both traction and hemostasis and allows for the necessary time to place additional sutures. Precautions to be taken at this stage are, to avoid entering the heart chamber with suture needle and to avoid the application of too much tension on the ties. A traction suture applied to the apex of the heart as advocated by Beck²⁵ and endorsed by Bigger,⁴ serves not only to control hemorrhage and facilitate the placing of sutures at the site of the wound, but also for visualization of trauma on the lateral and posterior cardiac areas by rotation traction. Interrupted sutures, widely spaced, are used to close the pericardium. Since pericardial effusion is inevitable because of the original trauma and irritation, a tight closure is not advisable. Bigger⁴ warns against placing a drain into the pericardial sac and favors the introduction of widely separated sutures, or allowing the lower portion to remain open. Elkin²⁴ places a drain of soft rubber down to the pericardium and orders its removal in forty-eight hours.

Cessation of the heart beat or fibrillation during the operation sometimes occurs in association with apical traction or handling. This emergency is treated by stopping the operation and allowing the heart to recover. If this is not prompt, adrenalin (1 cc. of 1:1000) is injected into the myocardium and gentle cardiac massage is started. This procedure is often rewarded by a return of heart function. In many cases in which injury to the coronary vessels required ligation, the outcome was frequently uneventful. Elkin²³ states that a fatal termination would be expected in such cases in which the patient is old and in which there is pre-existing coronary sclerosis. It is of interest to note an observation which has frequently been recorded; that contrary to expectations, during operation

under local anesthesia, the ligation of a coronary artery is not attended by pain nor is there pain present during heart suture even when this procedure throws the heart into strong contractions.

Beck and Cox⁹ conducted experiments on dogs to determine the effect of exposing the heart to atmospheric pressure. They found that the venous pressure was increased for a considerable time, the arterial pressure dropped 8 to 30 mm. of mercury, and the minute volume output of the heart decreased 15 to 30 per cent. When the opening was closed, the heart returned to normal. It was concluded that the atmospheric pressure acts as an air tamponade and causes a dilation of the pericardial cavity. The application of these observations to heart surgery are significant.

In view of recent knowledge on the subject of heparin, Bigger⁴ has advocated its usage postoperative in cases in which the wound has penetrated the heart chambers or injury to the coronary vessels has been sustained. Further postoperative care includes the use of the oxygen tent, Fowler's position for easy breathing and morphine for proper rest. The development of increased intrapleural fluid associated with pressure symptoms will require aspiration. Infection may necessitate rib resection for drainage. A close watch must be kept on the pleural and pericardial reaction, and indicated therapy instituted when the situation arises.

CASE REPORT

A. W., an eighteen year old white male, was brought to the Metropolitan Hospital by ambulance at 8:00 A.M. No history was obtainable; the patient was comatose and in profound shock. History given subsequently was that the patient had shot himself with a .22 caliber pistol at 2:00 A.M., six hours before admission to the hospital. Examination revealed a young male apparently in coma and shock, skin of face pale and cyanotic, in a cold sweat, and respirations slow, shallow and labored. There was a marked strutting of the veins in the neck and arms. The radial pulse was imperceptible and the blood pressure could not be ascer-

tained. Examination of the chest revealed a small, round wound $\frac{1}{2}$ cm. in diameter located about the fourth interspace and 2 cm. medial to the midclavicular line. The wound was not bleeding and there was a large amount of clotted blood on the skin and clothes. A darkened area which had the appearance of a burn similar to that of powder marks, encircled the wound. Posteriorly at the lower angle of the left scapula (Fig. 6), there was another small wound of about the same size and description except for the absence of a burn, probably the point of exit. On auscultation, the heart sounds were barely audible and muffled. The left side of the chest was flat to percussion and devoid of breath sounds. A diagnosis of bullet wound of the left chest with cardiac tamponade and lung injury was evident. With the patient still on the stretcher, a portable x-ray of the chest was obtained. (Fig. 1.) This was inconclusive except for evidence of diffuse clouding throughout the left lung field. The stretcher was wheeled into the operating room and to avoid disturbing the patient, it was decided to use the stretcher in place of the operating table. Skin preparation consisted of shaving, green soap scrub, benzine wash and tincture merthiolate. Tamponade was confirmed by aspiration of blood through the fourth interspace at the left margin of the sternum. Operation started at 9:00 A.M. Infiltration novocain anesthesia served to block the precordial area from the sternum to the left anterior axillary line and from the second to the sixth ribs. Inhalation of oxygen under positive pressure was maintained. A curved skin incision (Fig. 5) was made with its convexity touching the left margin of the sternum, starting at the third rib in the midclavicular line and terminating at a corresponding point on the sixth rib. The incision was deepened through the skin, fascia and pectoralis muscle, thereby exposing the fourth, fifth and sixth ribs, and the soft tissue flap was freed lateralward. The fourth and fifth costal cartilages were severed about 2 cm. from the left sternal margin and were then resected laterally for approximately 10 cm. The substernal muscle and fascia were opened and also retracted to the left thereby exposing the pericardium. On opening the pericardium about 500 cc. of blood escaped under pressure. With the aid of suction, the field was cleared and an actively bleeding perforation was noted on the margin of the left



FIG. 1. The heart and mediastinum appear to be in the midline. There appears to be fluid in the left pleural cavity, September 20, 1940.

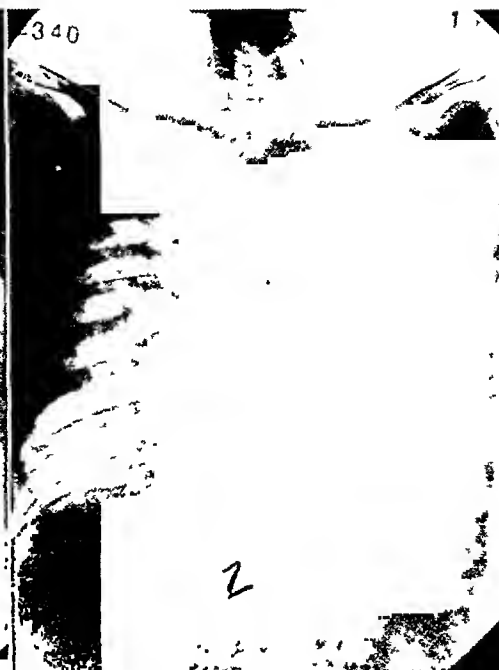


FIG. 2. Pleural effusion in left chest and congestion in the right lung field, September 23, 1940.



FIG. 3. There is further diminution in the amount of fluid in the left pleural cavity. The mediastinum and contents appear to be approaching the midline, October 2.



FIG. 4. Residual clouding along the left axillary margin of the type associated with possible plastic exudate. The heart shows no definite abnormality, October 24.

auricle close to the auriculoventricular junction. The pleura and overlying lung had also been penetrated by the passage of the bullet

catgut sutures were used to close the pericardium (except at its lateral border) and to approximate the layers of the chest wall to



FIG. 5.

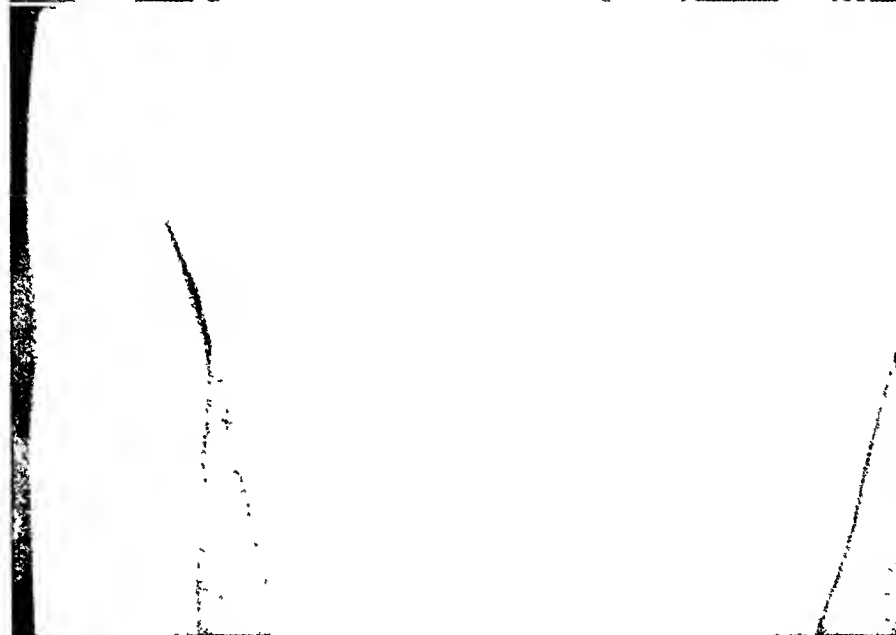


FIG. 6.

FIG. 5. Healed incision and site of entrance wound, November 6.

FIG. 6. Exit wound at inferior angle of scapula, November 6.

and the lung seemed to be completely collapsed. Hemorrhage was readily controlled by light digital pressure. A small tab of adipose tissue in close proximity to the heart wound was grasped with an Allis clamp which served in the capacity of a stay-suture, thereby facilitating the placing of a mattress suture of chromic No. 0 catgut which included the fat tab. This was all that was needed for complete hemostasis and closure. Interrupted No. 0 plain

their original position. The skin was closed with interrupted black silk sutures. The entrance wound was excised "en bloc" and later closed with one black silk suture.

Postoperative treatment consisted of shock therapy: heat and morphine, oxygen through a B.L.B. mask (followed later by an oxygen tent), and autotransfusion of 400 cc. of blood. This had been aspirated from the left pleural cavity, then citrated and strained through sterile

gauze. Desoxycorticosterone acetate (cortate 1 cc.) and 3,000 units of tetanus antitoxin were given. Pleural decompression for relief of

An electrocardiograph (Fig. 7a) taken within a few hours after operation was interpreted to present a right axis deviation probably due to

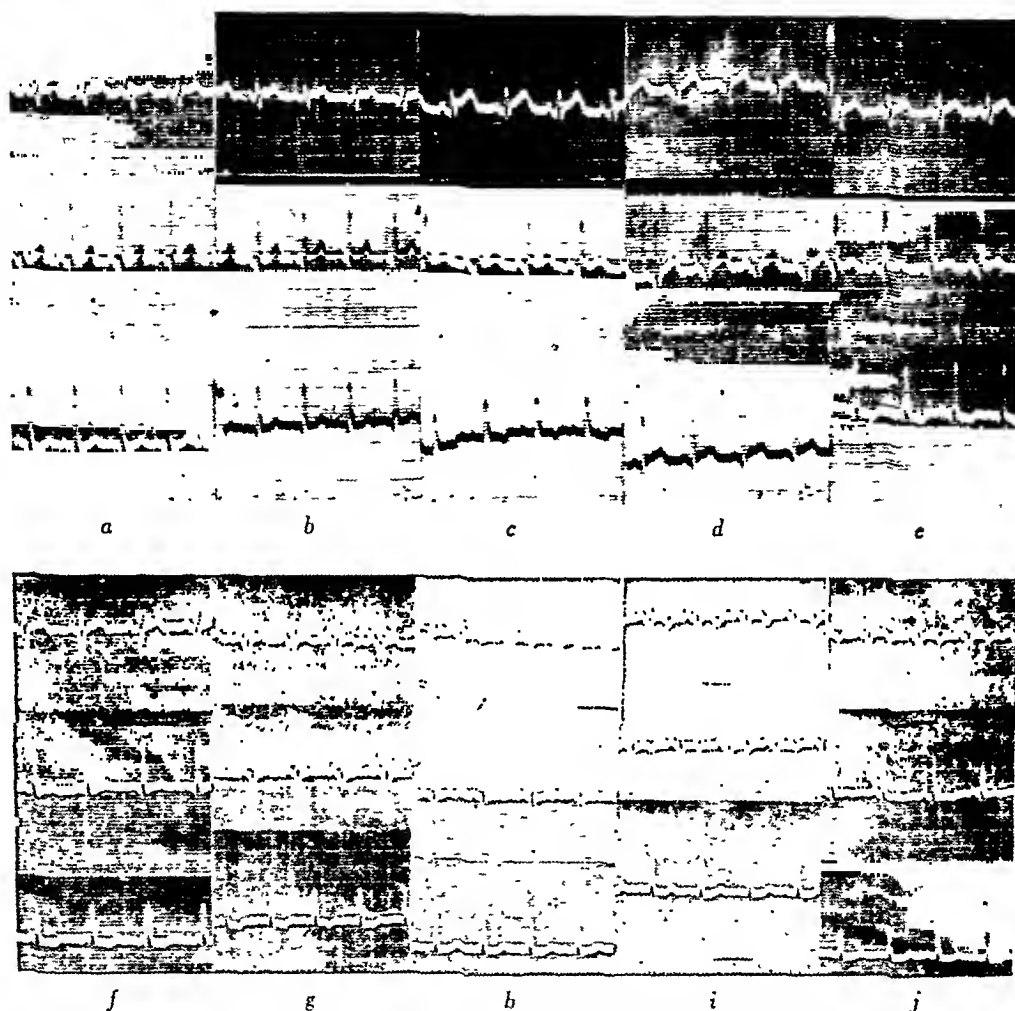


FIG. 7. Tracings a, b, c, d and e show evidence of pericarditis; perimyocarditis in progression with signs of healing apparent in f, g, h, i and j.

tension hemopneumothorax was obtained by inserting a needle into the fourth interspace in the anterior axillary line, leading the connecting tube under water to a bottle placed on the floor. This procedure revealed the presence of tension, as evidenced by the escape of air under positive pressure. The immediate postoperative arterial pressure was 100/50 and pulse 120 of good quality. This was maintained and the blood pressure rose to 170/76 in four hours, but returned to within normal limits in two hours; 7:00 P.M., pressure 100/50, pulse 126, respirations 26; 10:00 P.M., pressure 100/60, pulse 124, respirations 40. Within twelve hours the patient had reacted well enough to take large amounts of fluid by mouth.

pulmonary hypertension secondary to pneumothorax. In anticipation of infection, sulfanilamide (20 gr.) and sodium bicarbonate (20 gr.) were started immediately and given every four hours for twenty-four hours to be reduced to 15 gr. every six hours for the second and third days. Fluid intake for the first twenty-four hours was 6,500 cc., output, 600 cc.

On the morning of the second postoperative day, the patient was in a semicomatose state although the blood pressure, pulse and respirations remained unchanged. The temperature ranged between 100 and 101 degrees. A sanguineous discharge persisted in the drainage through the aspiration needle. In the afternoon, the blood pressure was 108, 64 and pulse 128

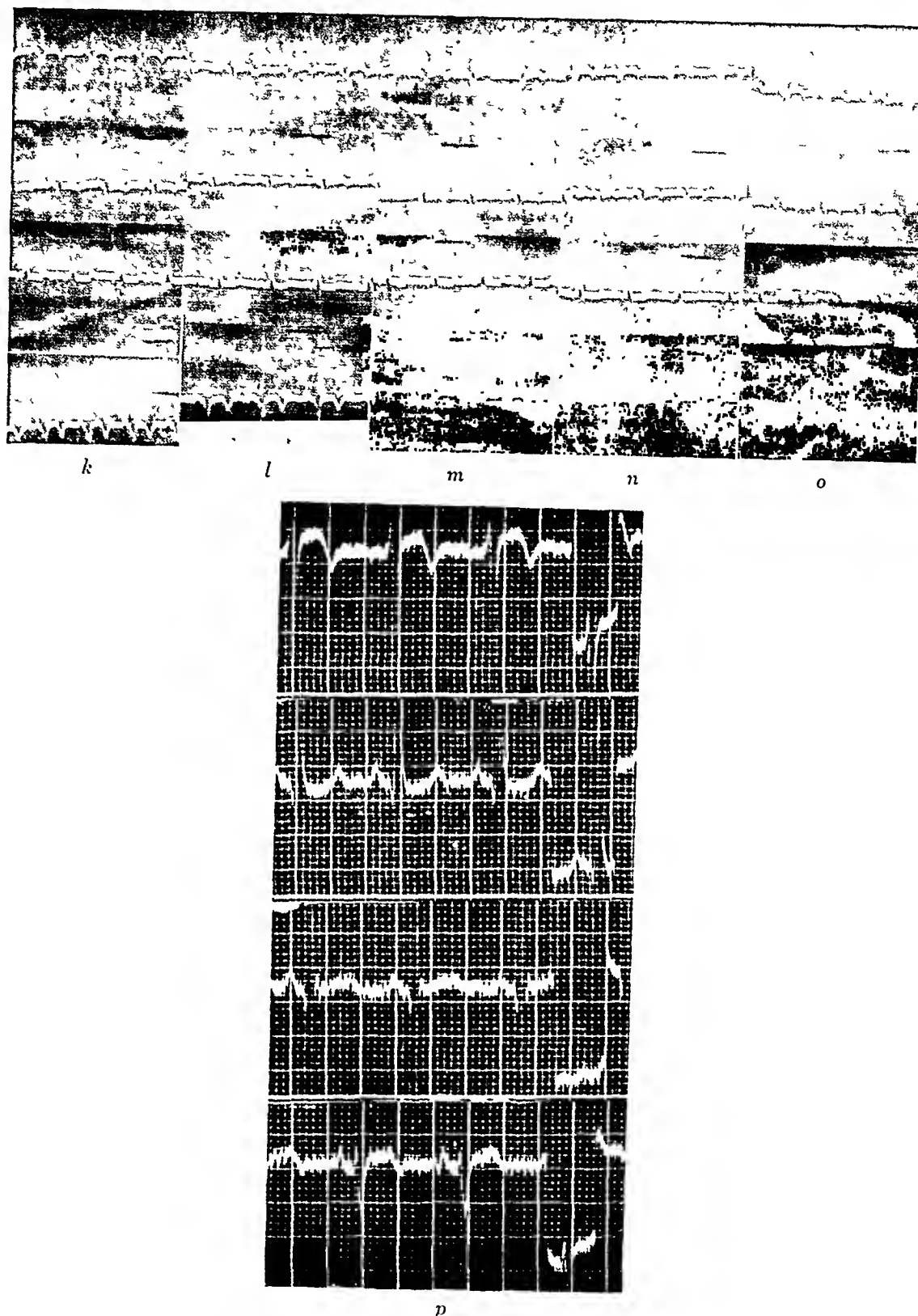


FIG. 8. *k*, *l*, *m*, *n* and *o* continuation of sequence as depicted in Figure 7. *p* shows right axis deviation and changes as seen in myocardial infarction when healing. Compared with the preceding tracings, the s_1 is deeper, T_2 is upright, ST_3 is more depressed, T_3 is more upright, R_4 is now positive and s_4 is deeper.

The patient became irrational. This was controlled by barbiturates. The venous pressure was 24 cm. at 1:00 P.M. and 20 cm. at 3:00 P.M. A transfusion of whole blood (300 cc.) was given preceded by 0.5 cc. of cortate to be repeated twice daily for the next few days. In the evening, the temperature had risen to 103.4 degrees, pulse 120, respirations 32, and blood pressure 110/66.

On the third postoperative day—6:30 A.M., the temperature was 103.4 degrees, pulse 124, respirations 28 and blood pressure 106/66. The patient was still irrational although occasionally lucid. The pneumodecompression drainage functioned satisfactorily with evidence of slight active intrapleural bleeding. By noon, the temperature was 102.8, pulse 120, respirations 32 and venous pressure 16 cm.

On the fourth postoperative day—8:30 A.M., the temperature was 103.5 degrees, pulse 122, respirations 36, blood pressure 116/66 and the pneumothorax drainage bottle still showed slight evidence of bleeding. In the evening, improvement became apparent. The pulse was 100, temperature 100 degrees and venous pressure 10 cm. Another blood transfusion (250 cc.) was given. The patient was rational. X-ray of chest (Fig. 2) indicated the presence of fluid in the left chest but no shifting of the heart or mediastinum.

On the fifth postoperative day, the general condition was fair: venous pressure 11 cm.; urine normal; blood—hemoglobin 54 per cent, red blood cells, 2,470,000; white blood count 15,000; polymorphonuclears 66 per cent; blood chemistry normal. Chest x-ray (Fig. 3) showed displacement of the cardiac shadow to the right and clouding of the left lung field due to effusion in the left chest.

On the sixth postoperative day, the temperature was still elevated (102 degrees); pulse 113; venous pressure 11 cm.; respirations 36 and blood pressure 106/52. The patient was rational and his condition fair. The dressing was changed, and a fluctuating area was noted in the center of the incision over the fourth rib. Probing released 30 cc. of green, thick, purulent exudate—smear showed many pus cells and Gram positive cocci in diplo and chain formation; culture subsequently revealed *Streptococcus hemolyticus*. A rubber drain was inserted into this superficial infection. *Streptococcus vaccine* was given intramuscularly (0.1 cc.) and 0.5 cc. on the two succeeding

days. Sulfanilamide was discontinued because of the low hemoglobin and red blood count. An electrocardiograph (Fig. 7c) showed evidence of pericarditis.

On the seventh postoperative day the temperature was at a lower level (100.2); pulse 88; respirations 40; venous pressure 15.5 cm.; blood pressure 106/60. Dyspnea was present without cyanosis. X-ray of the chest (Fig. 4) revealed an increasing enlargement of the cardiac shadow with the right border of the heart filling one-third of the right lower chest. This was thought to be either cardiac dilatation or pericardial effusion. The heart sounds at the apex were slightly muffled, but came through clearer over the sternal portion. Breath sounds in the left lower chest were absent—suggesting the presence of fluid. The character of the purulent discharge from the wound had changed from a thick, creamy consistency to a watery, sanguinous fluid. This evidence was in favor of the presence of a communication of the wound with the pericardium. A drain was inserted in the wound.

On the eighth postoperative day the temperature was still moderately elevated and dyspnea became marked. Aspiration of the left chest by suction resulted in the withdrawal of 850 cc. of serosanguinous fluid—negative for organisms on culture. The venous pressure then dropped to 11 cm; blood pressure 120/60. The patient was comfortable and improvement evident. The blood count showed improvement over the previous anemia—hemoglobin 64 per cent; red blood cells, 3,120,000. The electrocardiograms (Figs. 7d and e) indicated the presence of perimyocarditis.

The following month was not associated with any further complications. The temperature declined to normal levels within the next ten days; the venous pressures remained within normal limits. Drainage, apparently pericardial effusion, persisted until the wound healed in about three weeks. X-rays of the chest (Fig. 4) showed steady improvement. Electrocardiograms (Figs. 7f, g, h, i and j, and 8 k, l, m, n and o) evidenced some improvement in the perimyocarditis.

The patient was ambulatory on the forty-first postoperative day without any evidence of reaction and discharged from the hospital on November 9, 1940.

In a follow-up examination, November 30, the fluoroscope revealed diminished pulsation

at the ventricular apex, diminution of movement of the apex on respiration, diminution of movement of left diaphragm on respiration, size of heart within normal limits, good pulsations except at the apex and diaphragmatic attachment where the heart was immobile. The electrocardiogram (Fig. 8p) suggested changes as seen in myocardial infarction when healing. The patient had no subjective symptoms except for slight shortness of breath when walking on an upgrade. He had gained ten pounds, his appetite was excellent and he slept well.

DISCUSSION

On admission to the hospital, the patient presented sufficient signs of heart wound with tamponade to make an accurate diagnosis. Realizing that the time factor was all important in this case, and since the diagnosis was apparent, a venous pressure determination and fluoroscopy were omitted. The information derived from these two procedures would no doubt have completed the classical picture of the injury which has been so well described by Elkin, Bigger and others. The value of venous pressure determinations was illustrated on the seventh postoperative day. At that time, the clinical and laboratory reports indicated improvement in the patient's condition. But a rise in venous pressure and definite dyspnea gave warning of the presence of further pathology—tamponade and effusion. The withdrawal of 850 cc. of serosanguinous fluid from the chest resulted in a drop in venous pressure to a normal level with complete disappearance of the dyspnea.

This case also bears out the finding of most authors that subsequent disturbances are nearly always respiratory instead of cardiac. It is interesting to note that the time interval which elapsed before the patient was admitted to hospital was six hours. One can only speculate on the mechanism involved during this interval. Apparently, cardiac tamponade over a period of six hours would result in cerebral anemia and death would ensue. Furthermore, continued hemorrhage persisting over this period would also have a lethal

issue. Of course, this would depend on the rate of blood loss and the size of the heart wound. However, it is our opinion that the opening between the pericardium and pleura was of a ball-valve mechanism. Decompression into the pleural cavity probably occurred whenever the tamponade pressure reached a sufficiently high level. This built-up positive pressure would overflow into the negative pleural pressure sac. As an added factor, shock aided in slowing the circulation—with increased blood viscosity and a concentration in the capillary bed.

Our electrocardiographic tracings were normal at first and then changed because of pericardial effusion, myocardial alterations and an increased pulmonary load. As the effusion was absorbed, the tracings pointed to intrinsic myocardial changes, since the electrical impulses were later transmitted more directly without interference from a layer of fluid. Thus the anterior-like infarct picture presented itself and the tracings showed regression and improvement.

This is the only case in the literature of gunshot wound of the left auricle in which operation was successful. Anatomical studies on the cadaver verified the path transversed by the bullet. Missing the pulmonary vessels, aorta and important structures in the hilum of the left lung was indeed miraculous. This confirms the repeated observations so often noticed concerning the erratic course of bullets through the body.

In retrospect, there is no doubt but that a transverse incision would have been less time consuming in the opening and closing and the technical facility aided. Another point in the technic worthy of note is to remember the difficulty encountered in the removal of the ribs when one first cuts the costal cartilage instead of the rib. The information derived from a portable x-ray picture was of only little help in the diagnosis. The possible prophylaxis against pleural and pericardial infection played by the short administration of sulfanilamide is problematical in our case. The value of

cortate in combatting shock may have been useful. Autotransfusion was a valuable therapeutic measure. The persistent temperature elevation was probably due to pleural and pericardial effusion, which has been found so frequently as an irritative response to trauma.

SUMMARY

We present a case of bullet wound of the left auricle attended by successful suture and a general review of the literature on the subject of cardiac trauma. The value of decompression of both the pleural and pericardial sacs have been emphasized. Autotransfusion is of inestimable value in combatting shock. Desoxycorticosterone acetate is probably also of value in overcoming shock. Respiratory instead of cardiac sequelae are noted.

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SUBMUCOUS LIPOMA OF THE COLON*

REPORT OF A CASE

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BENIGN tumors of the gastrointestinal tract are comparatively uncommon.

Of these, submucous lipoma is the second most common tumor. Their infrequency in the colon and rectum can be judged by the fact that in 1937, Pemberton and McCormack,¹¹ in a comprehensive review, were able to collect only 116 cases. These tumors are interesting because their presence is rarely diagnosed preoperatively. Further, the great majority occur during the so-called cancer age—a fact contributing to the difficulty in diagnosis.

Three comprehensive reviews of lipoma of the gastrointestinal tract have appeared in the English literature. The earliest one is that of Stetten,¹⁴ who, in 1909, reported seventy-seven cases. These included, two of his own cases and the rest from the literature. The next review is that of Comfort⁴ who, in 1931, reported 181 cases of submucous lipoma of the gastrointestinal tract, including those of Stetten. The 181 cases included twenty-eight cases from the records of the Mayo Clinic and the remainder from the literature. Of the twenty-eight Mayo cases, three patients had been operated upon while twenty-five were cases in which submucous lipomas were found incidentally during 3,924 consecutive autopsies, an incidence of 0.6 per cent. Kirshbaum,¹⁰ in a review of 5,724 autopsies at the Cook County Hospital, reported an incidence of 0.2 per cent, while Staemmler, in 17,000 necropsies, reported an incidence of 0.05 per cent of these tumors in the gastrointestinal tract. The most recent comprehensive clinical review is that of Pemberton and McCormack,¹¹ who limited their study of submucous

lipoma of the colon and rectum. They collected 116 cases and included all of those previously reported at these sites. Ninety-seven of these were clinical cases while the remainder were found at autopsy. Thirteen additional clinical cases found in the literature since the publication of Pemberton and McCormack's paper are tabulated below. (Table 1.)

The clinical evaluation of these tumors to follow is based upon the three reviews mentioned above and fourteen additional cases since the publication of the last comprehensive review. These fourteen cases include our own.

Submucous lipomas are somewhat more frequently encountered in the large than in the small intestine. They are still less common in the stomach. Of the 181 cases reported by Comfort, ninety-two occurred in the large bowel, sixty-five in the small bowel and twenty-two in the stomach. In two cases, the data were insufficient for localization of the tumor. In the large bowel, the most frequent locations are the cecum, ascending colon, sigmoid flexure, transverse colon, rectum and descending colon in the order named. They are somewhat more commonly encountered in women and are most frequent in the fifth and sixth decades of life. The average age of the clinical cases as computed by Pemberton was 47.5 years. Of those cases seen at necropsy, the average age was sixty-three years.

Submucous lipoma of the large bowel, if small in size, may cause no symptoms whatsoever. This is testified to by the fact that they are found incidentally—although rarely—at autopsy. Eleven of the cases of

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TABLE I
THIRTEEN ADDITIONAL CASES OF SUBMUCOUS LIPOMA OF COLON SINCE PUBLICATION OF PENBERTON AND MCCORMACK'S REVIEW

	Weinstein Lieberman	Ross	Faber	Fetzer	Cabot	Kent Sawyer	d'Anella Touree	Tizianello	Weise	Weise	Julian	Cooper	Anderson Fansler
Duration of symptoms		7 yrs.	12 yrs.	7 yrs.	2 yrs.	3 das.	2 das.	2 mos.	8 wks.	?	3 wks.	2 wks.	10-20 yrs.
Constipation	+			+	+				+	+	+		+
Blood							+		+	+	+		+
Anemia											Note: had previous resec. (7 yrs.) for ca. of desc. colon		
Loss of weight													
Palpable tumor mass	Pedunculated	L. epig.	R. pelvis	R. epig.	L. epig.	None	R. hypoch.	Epig.	L.L.Q.	L.L.Q.	?		
X-ray diagnosis			Pericecal granuloma	Ca. (filling defect) hep. flex.	Benign tumor cecum	No exam.	No exam.	Ovoid mass trans. colon	Sten. tumor splenic flex. ca. ?	Sten. tumor splenic flex. ca. ?	Smooth filling defect trans. colon	No exam.	No exam.
Location of tumor	Rectum	Cecum	Cecum	Asc. colon	Cecum	All of colon. Multiple	Asc. colon hep. flex.	Trans. colon	Desc. colon at splenic flex.	Desc. colon at splenic flex.	Trans. colon	Cecum	Rectum
Evidence of intuss		+	+		+		+	...	...	...	...	+
Surgical treatment	Removal with cecostomy	Cecostomy	Resection	Resection	Resection	Resection died	Cecostomy	?	Resec.	Shelled out	Resec.	Mikulicz	Excision

submucous lipoma of the gastrointestinal tract found at necropsy at the Mayo Clinic were situated in the colon and rectum. Of

portion of the ascending colon which had become intussuscepted into the left side of the transverse colon. The barium enema

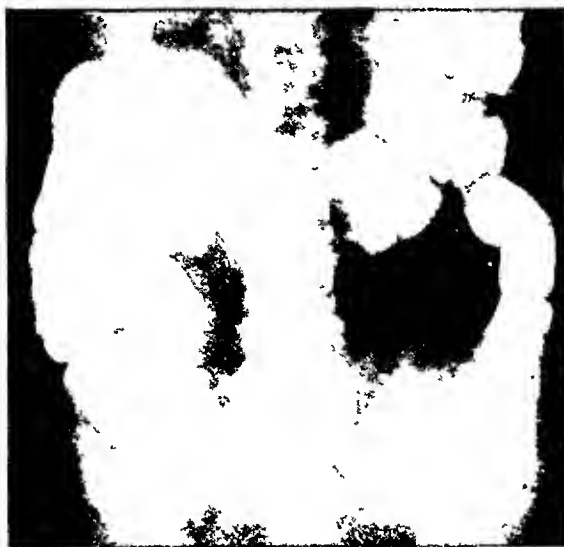


FIG. 1. Roentgenogram of colon following barium enema showing filling defect in midportion of transverse colon.



FIG. 2. Roentgenogram of colon three months after resection of tumor.

Kirshbaum's nine cases in 5,754 necropsies, two were in the colon. In none of these thirteen cases was there any record of symptoms referable to this tumor. The symptoms that are caused by these tumors may be ascribed to the pathologic changes that they undergo. A study of the clinical cases, that is, those patients operated upon, reveals that these tumors undergo three types of pathologic changes: First, because of growth, they cause obstruction by gradually encroaching upon the lumen of the bowel and interfering with the fecal current. This phenomenon is present in the great majority of the clinical cases. In the second group, comprising about one-third of the clinical cases, the tumor is associated with intussusception. As Stetten stated in his review of 1909, the tumor is usually at the apex of the invagination and probably interferes with peristalsis. It may be added, we believe, that the fecal flow may also serve to favor this phenomenon by propelling the tumor distalward. A rather noteworthy example of this phenomenon is reported from the Massachusetts General Hospital.³ In this report, there is a description of the visualization under fluoroscopy of the disinvagination of the cecum and a

passed freely to the left side of the transverse colon where it stopped in front of a rounded mass apparently occluding the lumen at that point. As the pressure of the barium solution was increased, the mass gave way and moved along the transverse colon, hepatic flexure and down to the midportion of the ascending colon. After evacuation, the mass returned to its original position in the transverse colon. This phenomenon was noted three times during the period of observation, twice with the use of a barium enema and once with insufflation of air. At operation, a polypoid pedunculated lipoma was found arising in the cecum 8 cm. distal to the ileocecal valve.

The third pathologic change characteristic of this tumor is erosion of its dome resulting in slow hemorrhage. This was present in about one-fourth of the cases reported by Pemberton. It was also present in our own case. In view of the fact that these tumors are usually attached to the wall of the bowel by a pedicle and, so to speak, float freely in its lumen, a fourth complication—strangulation of the tumor with resulting gangrene—would seem to be possible. However, probably because of the fact that the pedicle of these tumors oc-

curring in the colon is a broad one in the majority of cases, this phenomenon has not been reported. Any combination of the

ception. This phenomenon was noted either at operation or during x-ray studies in three of the six clinical cases reported from the

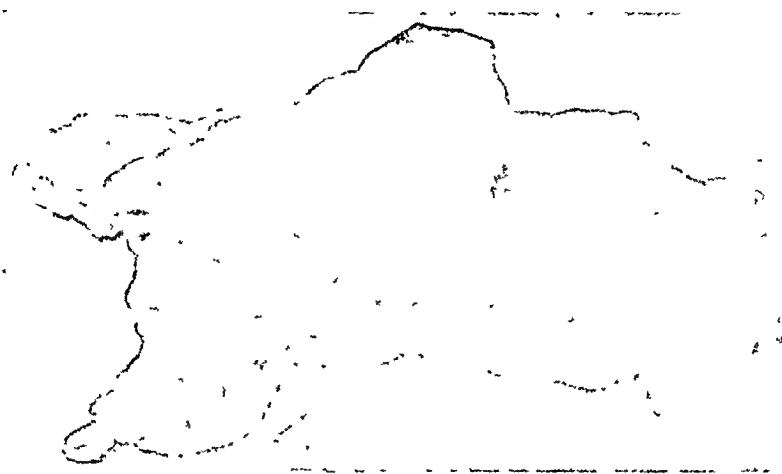


FIG. 3. Photograph of gross specimen.

three pathologic changes may co-exist in varying degrees. The combination most frequently encountered is that of obstruction with slow hemorrhage.

Clinically, the symptoms may be classified into two groups: In the first group, there is a long history of gradually increasing constipation with recurring attacks of pain in the abdomen often with nausea and vomiting, following particularly the intake of bulky or heavy foods. These attacks occur usually months or years apart, last several days and are often terminated by bloody, diarrheic stools. Between these attacks, the patient is comparatively comfortable except for the increasing constipation. The attacks may occur over many years—twelve years in Faber's⁶ case in which a submucous lipoma of the cecum was found at operation. The average duration of symptoms as computed by Pember-ton and McCormack in their reported cases was 41.5 months. The long duration of these symptoms, unaccompanied as they are by loss in weight, anemia or cachexia is characteristic of submucous lipoma of the colon.

In the second group of cases, the clinical picture is more acute—that of bowel obstruction in varying intensity. Into this group fall most of the cases of intussus-

ception.¹¹ This phenomenon was noted either at operation or during x-ray studies in three of the six clinical cases reported from the Mayo Clinic¹¹ and in four of the thirteen recently reported cases tabulated in Table 1. The symptoms in these acute cases are of a few days' or a few weeks' duration. Because of the great similarity between the clinical entity produced by an acutely obstructing lipoma and that so often produced by carcinoma, a diagnosis of benign tumor is rarely made. It is to be remembered that many of the chronic cases terminate with or come to surgery because of symptoms of acute bowel obstruction or severe pain.

X-ray studies of the colon are usually not very helpful in establishing a diagnosis of benign tumor. Most often, "carcinoma," "obstructive lesion" or "filling defect" is the report. This is of course understandable on the basis that lipoma, particularly when attached to a broad pedicle, will give rise to a filling defect suggestive of carcinoma. It is to be noted that in the six cases seen at the Mayo Clinic up to 1935,¹¹ a diagnosis of carcinoma was made in two cases, polypoid mass with a tendency to intussusception in one case, multilobular mass in the colon with a tendency to intussusception in another case and polypoid tumor in the remaining two cases. Of the thirteen tabulated cases, a diagnosis of carcinoma was made in three cases, that of benign tumor

with a suggestion that it may be a submucous lipoma in one case³ and diagnoses similar to those mentioned above in the remaining nine cases.

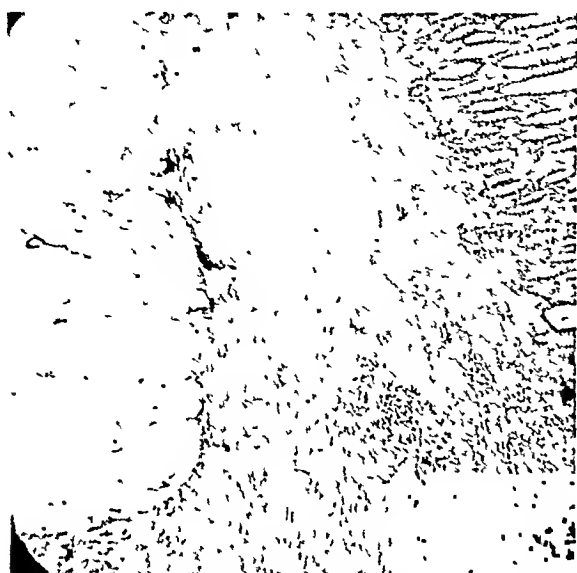


FIG. 4. Photomicrograph of nonulcerated portion of tumor. Note thickening of submucosa.

The surgical treatment of submucous lipoma depends upon the extent of the involvement of the bowel wall. In most of the reported cases, either resection in one or more stages or an exteriorization procedure was followed out. In a few cases, colotomy with primary repair of the bowel was performed.^{2,12,17}

CASE REPORT

Mrs. R. H., age forty-four, was admitted to the Mt Sinai Hospital on September 30, 1938 with the history that for six months prior to admission she had experienced attacks of low abdominal pain lasting two to three days, associated with five to ten bloody, diarrheic stools daily. She stated that during this period of six months she would often have a sense of fullness in the epigastrium, particularly after eating raw vegetables, fruits or heavy meats. These attacks occurred every two to three weeks. Between attacks, there was moderate constipation. She had had no symptoms referable to the gastrointestinal tract prior to the onset of these episodes. There was no loss in weight prior to or during this six months period. There was a history of hypertension for eight years. Her blood pressure had ranged between

164/90 and 230/115. There was nothing of further significance in the clinical history.

On physical examination, the only noteworthy finding was a blood pressure of 210/95.



FIG. 5. Photomicrograph of portion of dome of tumor showing ulceration of the mucosa and the membrane covering the lipoma over the ulcerated area. Membrane consists of leucocytic and fibrinous exudate with areas of granulation tissue containing giant fibroblasts.

The resident physician stated that he believed a mass was present in the upper abdomen. However, this finding was not corroborated by the attending physicians. Urine analysis revealed a faint trace of albumen. The benzdine test for blood in the stool was two to three plus positive on several examinations. The hemoglobin was 85 per cent, red blood cell count 4,260,000, white blood cell count 8,550 with the cells in normal ratio. The Wassermann and Kahn tests were negative.

Barium was administered by mouth. The small bowel and colon filled well up to a point a little to the left of the middle of the transverse colon where an obstruction was noted. The ascending and right half of the transverse colon were dilated. It was noted that the edges of the defect were well defined, but there was marked destruction of the mucosa on special films. The mass in the transverse colon was estimated to be the size of an apple. The roentgenologic diagnosis was carcinoma of the colon. (Fig. 1.)

At operation, (V. L. Schrager) an intrinsic tumor mass of the transverse colon about two to three inches to the left of the midline was

found. The transverse colon was opened and attached to its posterior wall there was found a roundish, gray-yellowish mass about the size

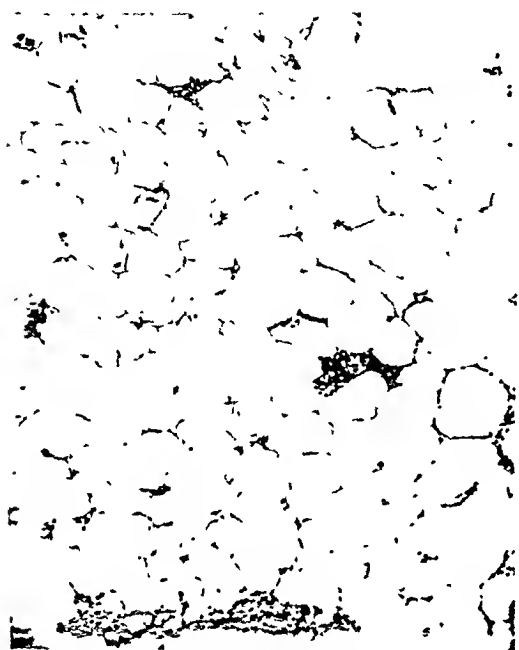


FIG. 6. Photomicrograph of lipoma. Note accumulation of lymphocytes and polygonal cells.

of a lemon which seemed to obstruct the lumen almost completely. The mass was attached to the bowel by a broad pedicle. A diagnosis of submucous lipoma was made. The bowel wall on either side of the mass appeared normal. About five inches of the colon including the mass was resected. The continuity of the bowel was re-established by an end-to-end anastomosis.

A Levine tube was placed into the duodenum on the first postoperative day and removed on the fourth day. Convalescence was uneventful except for a slight induration of the wound on the sixth day which cleared up rapidly with applications of heat.

In the gross examination of the specimen, Dr. Davidson, pathologist, noted that the lipoma, which measured 44 mm. in height, 50 mm. in length and 35 mm. in width, originated from the wall of the colon corresponding to its mesenteric attachment. (Fig. 3.) The tumor obstructed the lumen almost completely. Near its base, there was a papillary outgrowth 10 mm. in length. On section, the tumor was found to consist of fatty tissue enclosed by the mucosa. (Figs. 4 and 6.) Histologic examination revealed absence of mucosa in the dome of the tumor where there

was replacement by granulation tissue containing many giant fibroblasts. (Fig. 5.)

An x-ray study of the colon four months after the resection, January 25, 1939, revealed some narrowing in the region of the anastomosis. Three months later the transverse colon appeared perfectly normal. (Fig. 2.) The patient has had no recurring symptoms to date.

SUMMARY

1. Submucous lipoma of the large bowel is comparatively rare.

2. Because of its occurrence during the so-called cancer age, the similarity of the symptoms, particularly when acute, to those of obstruction due to carcinoma, and the absence of a characteristic defect on x-ray studies, submucous lipoma of the colon is rarely diagnosed preoperatively. In cases of suspected pathologic conditions of the colon presenting a long history of recurring attacks of pain, constipation, bloody diarrhea, unassociated with loss in weight or with cachexia, a benign lesion of the colon should be suspected.

3. Intussusception is a rather characteristic complication of submucous lipoma of the colon.

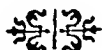
4. Thirteen cases of submucous lipoma of the colon and rectum found in the literature since the publication of Pemberton and McCormack's review in 1937 are tabulated.

5. A case report of submucous lipoma of the transverse colon is presented.

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STERILITY of the operative field is impossible to obtain in surgery of the rectum and anus except in a few operations which are performed through a perianal skin incision without entering the bowel lumen.
From—"The Rectum and Colon"—by Hayden (Lea & Febiger).

METASTATIC CARCINOMA IN THE UTERUS*

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METASTATIC carcinoma in the uterus is very rare. According to Virchow¹ those organs which are frequently the seat of primary tumors are seldom affected by metastatic growths; and according to Ewing² the uterus is the first on the list of organs affected by primary cancer.

The subject of metastatic tumors in the uterus is hardly mentioned at all in the literature, except in some instances when discussing carcinoma of the ovary and its relationship to carcinoma of the uterus. Because of the close proximity of the two organs and the intimate relationship of their lymphatics, it is often difficult to determine which of the two is the primary seat of the cancer. This is particularly true when the malignancy is limited to the pelvic organs.

Offutt,³ in 1932, reported 616 cases of papillary cyst adenocarcinoma of the ovary from the Mayo Clinic. Eight and six-tenths per cent of the cases were associated with carcinoma of the uterus; and in 521 cases of adenocarcinoma of the body of the uterus, there was associated carcinoma of the ovary in 11.9 per cent. Norris and Murphy⁴ in the same year reported ninety-three cases of malignant ovarian neoplasms, 11.8 per cent of which also involved the uterus.

Metastasis usually takes place by the lymphatic route and by contact implantation. Transtubal dissemination has been reported by Sampson,⁵ Clark and Norris,⁶ and Offutt. In several of Offutt's cases, carcinomatous cells were found in the lumen of the Fallopian tubes, while the blood vessels and lymphatic channels of the tubes were apparently normal. Two similar cases were found by Clark and Norris. The

latter believe that transtubal dissemination occurs in many cases of combined ovarian and uterine carcinoma. Ruge⁷ has demonstrated that 12 to 13 per cent of carcinoma of the Fallopian tubes metastasizes to the uterus.

Sampson advocates the ligation of the fimbriated end of the tubes before proceeding with the removal of the cancerous tissue, and the limitation of uterine curettage for fear that some of the curetings may make their way to the peritoneal cavity. One other suggestion may be added—the abolition of the uterine retractors which, when clamped forcibly down on the uterus, squeeze its contents through the Fallopian tubes into the peritoneal cavity.

Novak⁸ strongly supports the theory of lymphatic extension in cases of combined ovarian and uterine malignancy, and he questions the extension of the malignancy by contact implantation, although not denying its existence.

Metastatic carcinoma in the uterus from extrapelvic organs is extremely rare. Only fifty-six cases have been reported in the literature up to the present writing.

Thirty-one cases had their origin in the breast (55.4 per cent). Seventeen of them were reported by Töröck and Wittelshöfer⁹ from the Vienna Pathological Institute covering a period of sixty-two years (1817-1879). The others were single case reports. Two of the cases, reported by Franqué¹⁰ and Schaper,¹¹ occurred in pregnant women. The former gives a very good discussion on metastatic carcinoma of the uterus.

Fourteen cases had their origin in the stomach (25 per cent). One of these cases, reported by Senge,¹² metastasized to the placenta.

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Nine cases originated in the following organs: lungs three, pleura one, pancreas one, liver one, gallbladder one and kidney two. Two metastasized from melanocarcinoma. All cases came to autopsy.

Four additional cases of metastatic carcinoma in the uterus are here reported. Three originated in the breast, making a total of thirty-four cases of metastatic carcinoma of the uterus originating in the breast up to the present writing. The fourth case had its origin in papillary adenocarcinoma of the ovary.

CASE REPORTS

CASE I. *Metastatic Carcinoma in the Uterus, Primary in the Ovary.* A. K., a white female, aged forty-eight, was admitted to the Brooklyn Cancer Institute on November 3, 1939, for x-ray therapy, following a supracervical hysterectomy and bilateral salpingo-oophorectomy in another hospital. The operative diagnosis was papillary adenocarcinoma of the right ovary with metastasis to the uterus. This was confirmed by histological study.

The preoperative history consisted of abdominal pain and distention of five months' duration, irregular menses of two to three years, associated with passing of clots and excessive vaginal bleeding lasting from twelve to eighteen days. She was married and had two children. Her past history and family history were not relevant.

On admission to our institution the patient appeared well nourished but somewhat dyspneic. The abdomen was markedly distended with fluid. A palpable, freely movable tumor, the size of an orange, was found in the right upper quadrant. Pelvic examination revealed the stump of the cervix fixed by a palpable tumor in the posterior cul-de-sac and a nodular indurated parametrium. Following the removal of 1,100 cc. of straw-colored fluid by abdominal paracentesis, numerous nodules were felt throughout the abdomen. The rest of the physical examination did not reveal any noteworthy pathology.

The urine showed the presence of two plus albumin and numerous white cells, with some hyalin casts. The blood urea was 20 mg., creatinin 1 mg., and sugar 60 mg. The blood Wassermann test was negative. The blood count showed 3,240,000 red blood cells with

56 per cent hemoglobin. The white count was 20,100 with 89 per cent polymorphonuclear leucocytes and 21 per cent lymphocytes. An intravenous pyelogram revealed no pathological condition of the kidneys. X-ray of the chest showed no pathological condition of the lungs or heart.

The patient remained in the hospital under supportive treatment with repeated abdominal paracentesis and x-ray therapy to the abdomen. She died on April 17, 1940. An autopsy was performed and reported by Dr. Herman Bolker as follows: (1) Papillary adenocarcinoma of ovary with metastasis to the uterus (status postsupracervical hysterectomy and bilateral oophorectomy) with (a) peritoneal metastases involving the surfaces of all abdominal viscera, with ascites, (b) peritoneal fibrosis, with multiple adhesions, (c) metastases to iliac lymphnodes and retroperitoneal tissues, (d) cervical erosion, and (e) subacute urocystitis. (2) Right fibrous pleurisy, (3) chronic cholecystitis with cholelithiasis; and (4) aortic atherosclerosis.

CASE II. *Metastatic Carcinoma in the Uterus, Primary in the Breast.* B. B., a white female, aged fifty-five, was admitted to the Brooklyn Cancer Institute on November 9, 1937, complaining of pain in a postoperative mastectomy scar and pain in the right hip radiating to the back.

In February, 1935, she noticed a small lump in her breast associated with pain in her right arm. She was admitted to a hospital where a diagnosis of carcinoma was made. The diagnosis was confirmed histologically following a radical mastectomy. The patient later received postoperative deep x-ray therapy.

Two years later, May, 1937, she developed a mass in the right axilla associated with pain and difficulty in manipulating her right arm. The tumor disappeared four months later following the insertion of twelve radon seeds by a private physician. Two months later she was admitted to our Institution.

She had never had any other illness. Her menopause was three years previous to admission. Her family history was irrelevant.

Physical examination revealed a well developed, well nourished white female, not acutely ill. A firm fixed gland, measuring 2 cm. in diameter, was found in the right supraclavicular region. The right breast was absent. There was no evidence of any recurrence. En cuirasse nodules were present in the chest wall. The left

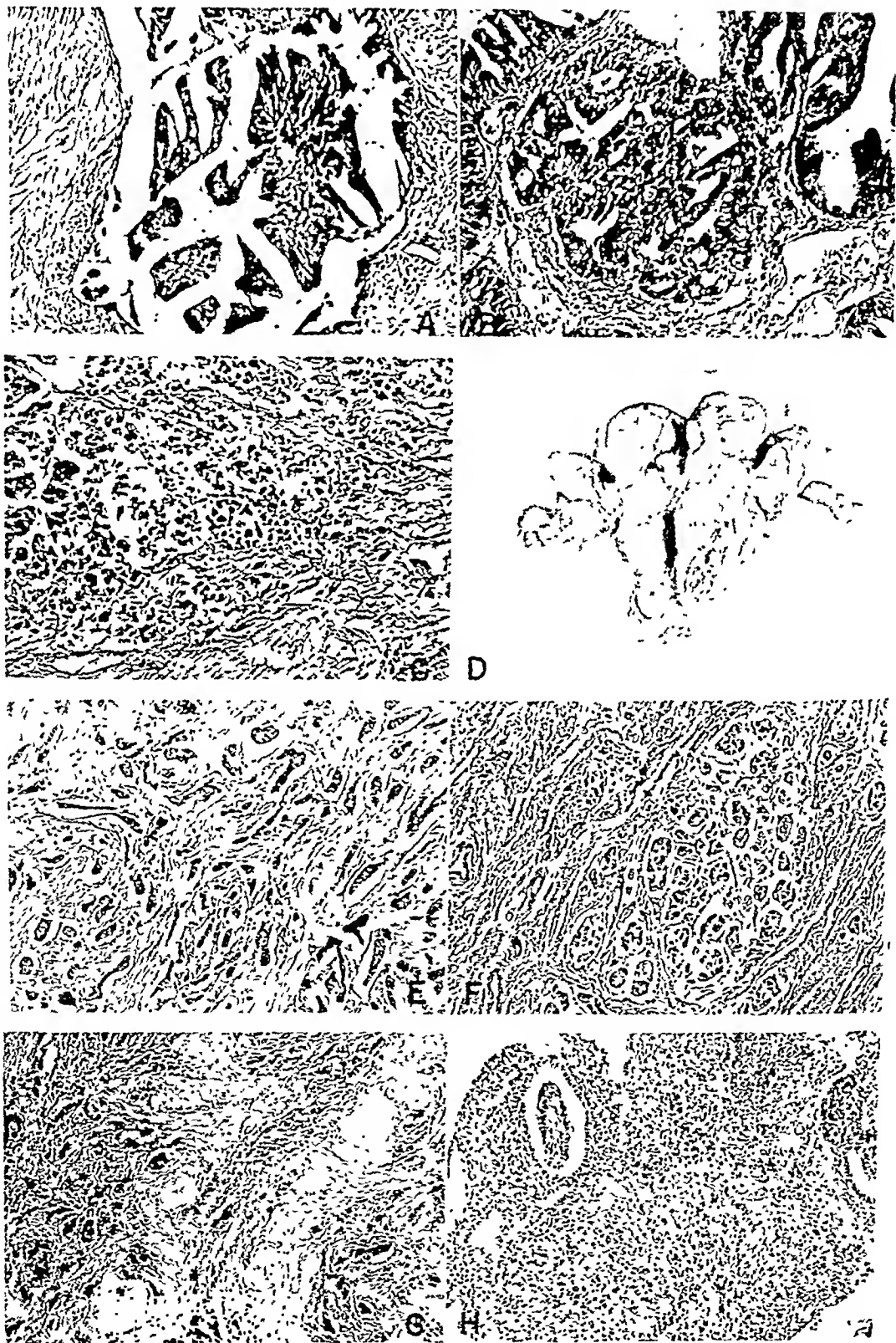


FIG. 1. Photomicrograph showing A, papillary adenocarcinoma of the ovary and B, metastasis in the uterus; E and G, primary carcinoma of the breast; C, D, F and H, metastatic carcinoma in the uterus. 180 X.

breast was free from tumefaction. A moderate amount of induration was found in the right axilla. Her heart and lungs did not reveal any evidence of pathological conditions. The abdomen was free from any palpable tumor. Pelvic examination revealed a partially stenosed introitus and an enlarged uterus diagnosed as a fibroid. The blood Wassermann test was negative. The blood count, blood chemistry and urine examination were within normal limits. Roentgenographic study of the lungs and skeleton revealed a metastatic lesion and partial destruction of the second lumbar vertebra with no other evidence of metastatic involvement.

The patient received deep x-ray therapy to the right supraclavicular area and lumbar spine, resulting in relief of her symptoms. She was followed up in our clinic.

Three months later she was readmitted to the hospital complaining of vaginal bleeding, recurrent back pain and inability to move her bowels for ten days. She stated that her rectum was closed and was unable to admit the enema tube.

At this time the patient appeared jaundiced. The nodule in the right supraclavicular region was twice its former size. The lower portion of her abdomen was distended. A metastatic nodule measuring 3 cm. in diameter was palpable near the umbilicus. She had a large indurated mass in the posterior vaginal wall pressing on the rectum. The rectal opening was very small and constricted. Roentgenographic examination at this time revealed metastatic involvement of the right femur in addition to the destruction of the second lumbar vertebra present at her previous admission.

The patient was kept comfortable under supportive treatment. She died March 8, 1939. Autopsy performed by Dr. Bolker was reported as follows: (1) Carcinoma of the right breast (postoperative radical mastectomy) with metastasis to the substernal, tracheobronchial and retroperitoneal lymphnodes, lungs, liver, peritoneum, spleen, uterus, ovaries, vagina, rectum, second lumbar vertebra; and (2) acute purulent pneumonia.

CASE III. Metastatic Carcinoma in the Uterus. Primary in the Breast. P. D., a white female, aged forty-eight, was admitted to the Brooklyn Cancer Institute on January 13, 1940, complaining of pain and swelling of her left arm and neck, backache, pain in the left hip and knee.

In March, 1936, she had a radical left mastectomy in another hospital. She received

preoperative radium treatment and postoperative x-ray and radium therapy. She returned to the same hospital three years later with metastatic involvement of the dorsal spine and was treated with alcohol block, cobra venom, and large doses of morphine for intractable pain. She was later referred to the Brooklyn Cancer Institute for supportive treatment.

Examination revealed a white adult female, chronically ill, poorly nourished, confined to bed. The left pupil was smaller than the right, with a drooping of the upper lid, showing evidence of Horner's syndrome. The cervical glands were bilaterally enlarged, extending from the supraclavicular area to the occiput. The skin of the neck showed marked radiation changes with pigmentation. Similar radiation changes were found over the chest and upper portion of the abdomen. Numerous en cuirasse nodules were present over the chest wall. The right breast was firm and solid. The nipple was retracted and the skin was covered with en cuirasse nodules. The left upper extremity was more than twice the normal size. The lymphedema included the fingers, which were contracted and deformed.

The skin of the left upper portion of the abdomen was edematous and nodular. The liver was enlarged to two to three fingers below the costal margin. Both gluteal regions were lymphedematous. The entire course of the spine was very tender on palpation.

The blood count showed 3,860,000 red cells with 73 per cent hemoglobin and 10,450 white cells with 66 per cent polymorphonuclear leucocytes, 27 per cent lymphocytes and 7 per cent monocytes. The blood chemistry was within normal limits. The blood Wassermann test was negative. Roentgenographic examination revealed widespread metastasis of the fourth, fifth, sixth, seventh, eighth and twelfth thoracic, first, second and third lumbar vertebrae, sacrum and pelvis.

The patient was kept comfortable with supportive treatment until April 9, 1940, when she expired. An autopsy was performed and reported by Dr. Bolker as follows: (1) Carcinoma of left breast with (a) metastases to skin of chest wall, tissues of neck, left pleura with effusion and pulmonary atelectasis, hepatic portal lymphnodes with dilatation of right hepatic bile duct, omental nodes, vermiform appendix, left ureter with mild hydronephrosis,

urinary bladder, uterine wall (fundal and cervical), left Fallopian tube and round ligament, gastric and rectal serosae; (b) edema of left upper extremity; (c) radiation changes, skin of chest; (d) status post right radical mastectomy. (2) Acute purulent bronchopneumonia; (3) cavernous hemangioma of liver; (4) adrenal medullary calcification; (5) myoma uteri; and (6) atherosclerosis.

CASE IV. Metastatic Carcinoma in the Uterus, Primary in the Breast. F. C., a white female, aged forty-seven, was admitted to the Brooklyn Cancer Institute on February 1, 1940, complaining of a lump in a postoperative mastectomy scar. In June, 1936, she had a radical mastectomy in another hospital. The pathological report was duct cell carcinoma, alveolar in origin. The diagnosis was confirmed in our Institution. Following operation she was in excellent health for three and one-half years. Three months previous to admission to our Institution, she noticed a lump in the postoperative scar. This was associated with some loss of weight and general weakness.

Her menstrual periods began at the age of eleven, were always regular, lasting for four days. For the last six months she had marked dysmenorrhea and profuse menorrhagia, which left her in a very weak, rundown condition. Her past history and family history were uneventful.

Examination revealed an adult white female, somewhat anemic in appearance, moderately well nourished. Several pea-sized nodules were present over the mastectomy scar. The surrounding skin was contracted and firmly adherent to the chest wall. Similar nodules were present over the manubrium sterni and epigastric region. The right arm was lymphedematous, as was the left breast, but there was no palpable tumor present within the breast. The supraclavicular and axillary glands were not enlarged.

Pelvic examination revealed the cervix to be larger than normal and cystic. The fundus was firm and enlarged to the size of an eight months' gestation. The uterus was freely movable in all directions. The adnexa were free from any tumefaction. The rest of the physical examination did not reveal any evidence of a pathological condition.

The urine was not pathologic; the blood chemistry was within normal limits; the blood Wassermann test was negative. The blood count

showed evidence of a low grade anemia, but was otherwise normal. Roentgenogram of the chest and pelvis showed no evidence of pulmonary or osseous metastasis.

A biopsy from one of the chest nodules was reported as metastatic in origin. The curettings from the cervix and fundus were also found to be metastatic carcinoma of mammary origin. The pathological report by Dr. Bolker was as follows: Microscopic examination: The endometrium consists of numerous tortuous glands in the secretory phase. There is some swelling of the stromal cells. In spotty areas there is an invasion of groups of atypical cells which occur in rows or small alveoli. They occasionally surround the uterine gland without causing its destruction. The individual cells are polygonal in outline, with a deep pink cytoplasm, and vesicular or markedly hyperchromatic irregular nuclei. One area shows an invasion of the uterine musculature. There is a heavy localized infiltrate of lymphocytes and polymorphonuclear leukocytes. The cervix is lined by intact histologically normal layer of stratified squamous epithelium. Deep in the stroma paravascular are small groups of atypical cells which strongly resemble those of the uterine lesion. They are surrounded by fibrous tissue, the bundles of which are collapsed. Diagnosis: Metastatic carcinoma of uterus, fundal and cervical.

The patient received 1,500 mg. of radium into the uterus and a similar amount in the form of radium needles to the nodules of the skin.

On June 4, 1940, an exploratory laparotomy was performed. Multiple greyish, white nodules were found covering the peritoneal surface of the uterus, tubes, the serosa of the small intestine (ileum) and the peritoneum of the lower abdominal wall. The para-aortic glands were enlarged. The liver was not involved. Several of the nodules were removed for histological study and were reported as metastatic carcinoma of breast origin.

The patient is now convalescing in the hospital and receiving radiation therapy to the pelvis.

SUMMARY AND CONCLUSION

1. Metastatic carcinoma in the uterus is very rare. When it does occur, the primary lesions, in order of frequency, are: ovary, Fallopian tubes, breast and stomach. Cases

with primary lesions in the lungs, pleura, pancreas, liver, gallbladder and kidney, as well as two melanocarcinomas, are reported.

2. Still rarer are metastatic tumors in the uterus of extrapelvic origin.

3. Only fifty-six such cases were reported in the literature.

4. Four additional proven cases of metastatic carcinoma in the uterus are here reported from the Brooklyn Cancer Institute. Three had their origin in the breast and one in the ovary.

5. Of the fifty-nine cases of metastatic tumor in the uterus of extrapelvic origin, thirty-four or 57.6 per cent had their origin in the breast.

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DEEP CAVERNOUS HEMANGIOMA OF THE NECK

CASE REPORT

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RECENT experience with a case of non-pulsating, cavernous hemangioma in the neck caused me to review the literature dealing with this type of tumor in an attempt to clarify practical points in the differential diagnosis of tumors of the neck. It is my belief that these angiomas are not rare in occurrence and that dissemination of the knowledge of the cardinal signs of this lesion will result in a higher percentage of permanent cures. This case report describes this type of angioma as subcutaneous without involvement of the overlying skin, erectile, without bruit or pulsation.

Investigation of the literature shows that there is lack of agreement regarding the nature, the classification and the nomenclature of angiomas. MacCallum¹ believes them to be neoplasms, stating, "A true hemangioma is distinguished from a mere dilatation of capillaries or venules belonging to the general circulation by the fact that its blood channels grow independently without regard to the laws which govern the distribution of such vessels." He emphasizes the fact stated by Ribbert² that injections of solutions or substances into these tumors spill over very slightly, if at all, into the blood stream. Aschoff³ likewise considers them as new growths whose vessels develop from mesenchymal syncytium and have a luxurious connective tissue foundation. He believes true angiomas to be congenital and refers to the cirroid aneurysms and other abnormal arteriovenous communications as altered, hypertrophied and expanded blood vessels of normal derivation. Kaufman⁴ classifies hemangiomas as simplex or hyperplastikum, depending on whether the dilatation of the vessels or the formation of new vessels predominates.

Reid's comprehensive study of this subject inclines him to the belief that both angiomas and cirroid aneurysms are caused by a traumatic or congenital pathological condition and he looks upon both as abnormal arteriovenous communications rather than as neoplasms. The following is quoted from Reid: "The histogenesis of simple angiomas is not definitely agreed on. Most all authors of textbooks on pathology mention the controversy that has existed for a long time over the advisability of calling angiomas true tumors. Everyone agrees that the vascular endothelium may give rise to tumors possessing the properties of independent growth and even of metastasis. Examples of such growths are the hemangio-endotheliomas, pigmented nevi, and the hemangioma simplex described by Borrmann. Yet the great majority of so-called angiomas are composed simply of swollen blood vessels and do not exhibit the qualities of independent growth characteristic of true neoplasms. For this class of angiomas Albrecht, who considered them to be due to developmental defects, suggested the term of hemartoma. A strong opponent of the neoplastic nature of angiomas is Adami. Thoma considered mechanical factors a very important influence in the growth of angiomas. Others (Rokitansky and Borst) regarded many of them as simple hypertrophy of vascular segments without neoplastic growth. Unna, perhaps noting the frequency of simple angiomas in certain locations of the body, suggested that they were due to abnormal pressure exerted during fetal life. Others (Ewing, MacCallum, Aschoff, etc.) while stating the controversy over the histogenesis of angiomas, are inclined to treat them as neoplasms or partial neoplasms arising from a displaced segment of the

vascular bed which comes to possess a limited power of an aberrant growth. Although my researches do not yet furnish definite proof of the etiology of simple angiomas, I cannot escape from the conclusion that they are dilatations of the small arteries and veins caused by a traumatic or congenital abnormal communication between the smallest arteries and veins. They are, I believe, arterio-venous communications (without the medium of capillaries) between the arterioles and venules."

In agreement with Reid's belief Homans⁶ states that: "Basically all such as are not of traumatic origin belong to one family: that is they are failures of development in the common capillary plexus of the embryo from which the arteries and veins are evolved. All are apt to be called angiomas, or hemangiomas, with the implication that they grow." The essential difference between hemangiomas and cirroid aneurysms seemed to him to be merely a matter of the size of the vessels between which the communication occurs. Homans emphasizes the supply of arterial blood without pulsation in both the capillary and the cavernous angiomas.

Rankin and Chumley⁷ have chosen the following simple classification with which most authors agree: (1) Angioma simplex (capillary angioma); (2) angioma cavernosum (cavernous angioma); and (3) angioma simplex hypertrophicum (angio-endothelioma).

In the third group fall the lesions resembling true neoplasms. Borderline lesions varying from simple angioma with proliferating endothelium to true angio-endothelioma are difficult to classify as are also the invading and metastasizing tumors of vascular endothelial origin. Such cases have been reported by Borrmann,⁸ Schmitt,⁹ and Ernst.¹⁰ Arteriovenous fistulae or aneurysms may be considered as a variation of classes 1 or 2, or as a separate clinical entity. I prefer to classify them apart from the true angiomas.

CASE REPORT

E. F., a six year old girl, was admitted to the Wilmington General Hospital May 26, 1939. While recuperating from pneumonia four years previously, she developed a marble-sized mass in the left side of the neck. It was not tender and it never discharged externally. This mass gradually increased to about the size of a hen's egg in the four-year period. Every month or so the child developed fever, sweats, anorexia and slight dysphagia. On these occasions the mass enlarged to three times its normal size. There were no choking sensations, aphonia or stridor. The diagnosis on admission was branchiogenic cyst. Family history and past history revealed nothing significant.

Physical examination revealed the temperature to be 99.2 degrees, pulse 100, respiration 22. The patient was a moderately well nourished child of six years, quite comfortable in a supine position. There was no cyanosis or dyspnea. The pupils were equal and reacted normally. The head was unremarkable. No respiratory stridor, dysphagia or dysphonia was demonstrable. In the left anterior cervical triangle was a round, smooth swelling, the size of a hen's egg, extending from the anterior median line of the neck to the anterior border of the sternomastoid muscle and from the level of the hyoid bone to a little below the cricoid cartilage. (Fig. 1.) It moved with deglutition and firm steady pressure caused it to disappear partially only to reappear rapidly upon release. No bruit or murmur could be heard. It did not transilluminate and, when compressed, small pea-sized nodules could be felt along its medial portion. Hard, enlarged, nontender lymphnodes were palpable in the right posterior cervical triangle and at the angle of the mandible on the right. The mass was not attached to the skin and there was no discoloration of the overlying skin. Cutaneous temperature was normal over the tumor. The heart, lungs and abdomen showed no abnormalities. The rate and rhythm of the pulse were normal.

Hemoglobin was 88 per cent, erythrocytes 5,000,000, leukocytes 6,000, differential blood count; neutrophils 63 per cent, lymphocytes 35 per cent, young neutrophils 1 per cent, eosinophiles 1 per cent. Urinalysis was negative. Blood Wassermann test was negative. Throat

culture showed growth of pneumococci and staphylococci.

X-rays showed swelling in the soft tissue of

Five days after admission, operation was performed. A tortuous, cirroid mass of dilated blood vessels was exposed. A distinct capsule

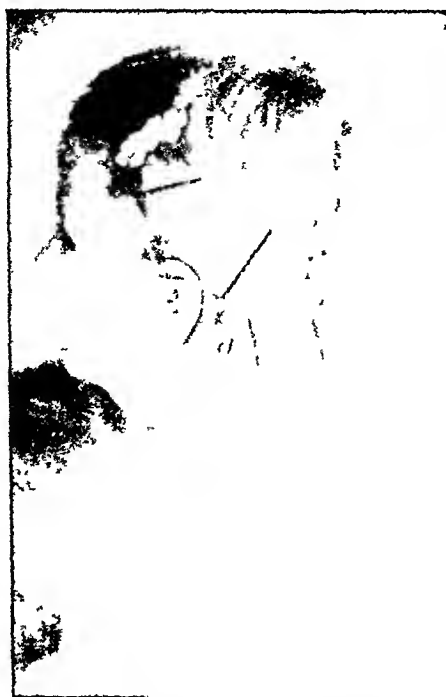


FIG. 1. Hemangioma of the neck before operation, taken May 30, 1939.



FIG. 2. Same patient after operation; taken July 19, 1939.



FIG. 3.

FIG. 3. Microscopic section of the tumor showing blood spaces, both distended and collapsed, in a dense connective tissue stroma. $\times 50$.

FIG. 4.

FIG. 4. Same as Figure 3 Showing blood space line with a single layer of endothelial cells. $\times 225$.

the left side of the neck and calcification just below the hyoid line on the left. Aspiration of the mass yielded unmixed blood. This procedure caused the tumor to shrink in size only to refill rapidly.

which was readily differentiated from the surrounding structures was dissected out. Posteriorly this was firmly adherent to the hyoid bone and laterally it blended inseparably with fibrous tissue in the region of the carotid sheath.

It received an abundant supply of blood from this region although the individual vascular channels could not be identified. Within the dilated veins were several calcified phleboliths.

DISCUSSION

The evidence of an associated inflammatory process in conjunction with the lesion

TABLE I
DEEP CAVERNOUS HEMANGIOMAS OF THE NECK REPORTED IN THE LITERATURE

No.	Author	Patient's Age	Sex	Treatment	End Result
1	Carnett, J. B.	20 yrs.	F.	Surgical excision	Cured
2	Carnett, J. B.	28 yrs.	M.	Surgical excision	Cured
3	Lincoln, R. P.	33 yrs.	M.	Electrical coagulation ("electrolysis")	Cured
4	Lediard, H. H.	6 mos.	?	Surgical excision	Cured
5	Rankin, F. W. Chumley, C. L.	38 yrs.	M.	Surgical excision	Cured
6	Eliot	35 yrs.	M.	1. Surgical excision 2. Surgical excision	1. Recurred 2. Cured
7	Sutter, H.	?	?	?	?
8	Giraldes	?	M.	Injection with bichloride of iron	Cured
9	Volkman (Eisenreiter)	4 yrs.	F.	Surgical mass ligation in stages	Death
10(?)	Kronlein (Eisenreiter)	12 yrs.	M.	Surgical excision	Cured
11(?)	Israel (Eisenreiter)	16 yrs.	M.	Surgical excision	Cured
12	Kuster (Eisenreiter)	10 yrs.	M.	Attempted surgical excision	?
13	Eisenreiter	19 wks.	F.	Ligation with silver wire	Death

The mass was excised and a small rubber tissue drain was inserted.

The postoperative course was not remarkable except that there was a low grade inflammatory reaction with induration about the wound. The temperature rose to 101 degrees on the first two postoperative days.

Microscopic examination showed striated muscle with perivascular infiltration of polymorphonuclear leukocytes. The connective tissue showed many dilated vessels. Several areas of calcification presented. Diagnosis: Cavernous hemangioma with calcification and inflammatory reaction.

On February 12, 1941, twenty-one months after operation, the scar was minimal and there was no recurrence of the swelling. No bruit could be heard over the area.

in the case herein reported lends support to the contention of Billroth¹¹ that angiomas or cirroid aneurysms are caused by inflammatory changes in blood vessels. Carnett¹² in his report of two cases commented on this association and also on the presence of calculi in this type of angioma. In the case herein reported the history suggests repeated inflammatory episodes. These lesions have been known to undergo thrombosis and ultimately to disappear following infection. Important points in the differential diagnosis include the compressibility of the swelling, its increase in size on straining or coughing (a phenomenon not present in the case reported), the presence of a bruit or thrill, the aspiration of blood

and the presence of calcification demonstrated by roentgenogram. The angiomas must be differentiated from acrocyst (air cyst), hypertrophy of the thyroid gland with excessive vascularity ("windy goiter") and hernia of the lung.

Table 1 shows that surgical excision has been employed commonly as the method of treatment in thirteen cases of which authentic reports have been found. As there are reported cures by injection, this method is considered as acceptable particularly since the connection of these angiomas with the general circulation is indirect and restricted. Peyton and Leven¹³ have reported on the treatment of angiomas by injection. There are reports of the successful employment of radium and x-ray in the eradication of these angiomas. The frequency of occurrence of deep cavernous angiomas in the cervical region was reported on by Eisenreiter who listed thirty-five in this region in a complete report on 1,098 angiomas. Gessler found only five cervical angiomas among 221 cases while Maas reported one out of seventy-two cases.

SUMMARY

1. A brief review of the literature regarding hemangiomas has been presented, together with the prevalent views concerning their true nature.

2. The personal case of a deep cavernous hemangioma of the cervical region, cured by operation, was given in detail.

3. The differential diagnosis and treatment were discussed briefly.

4. References to thirteen similar cases are offered.

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SUBUNGUAL MELANOMA

REPORT OF A CASE

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SUBUNGUAL melanoma shares with melanoma of the eye the most favorable prognosis of this highly fatal type of new growth.¹ However, the favorable prognosis depends upon prompt recognition and adequate treatment.

There is no tumor more available for detection and for appropriate treatment than subungual melanoma. The average patient with this condition will, nevertheless, undergo a period of meddlesome treatment which will materially mitigate against his recovery. The explanation for this fact is that the possible diagnosis is not considered by the physician in his first examination.

This study deals with (1) the incidence of the tumor, (2) its recognition, (3) its treatment and (4) a presentation of a case which, despite its fortuitously favorable progress, examples the difficulty of diagnosis and the pitfalls of therapeutic effort.

INCIDENCE

One is impressed in considering the incidence of tumors of this type with the confusion in nomenclature. Subungual melanoma is known also as melanoblastoma, melanoepithelioma and melanosarcoma of the nailbed,² onychial melanoma and malignant whitlow.³ One finds also that the term melanoma is used variously to include such benign lesions as the pigmented nevus.⁴ In addition, tumors of this group have been variously called melanoepithelioma and melanosarcoma dependent upon the predominant type of cell and the pathologist's opinion as to the origin.

While the rarity of the lesion has been indicated by such statistics as those of White⁵ who found no cases in 485 patients with various nail diseases, by the statistics

of Farrell⁶ who found only 2.6 per cent subungual melanoma in 265 cases of melanotic tumors, and the statistics of Affleck⁷ with approximately the same incidence of subungual melanoma in melanotic tumors, it was considered interesting to determine the incidence in our own vicinity. Therefore, 18,752 new hospital admissions were studied dating from 1927 until 1940. A total of five melanotic tumors of various types were included in the diagnoses and of these only one, the present case, was a subungual melanoma.

RECOGNITION

Melanomas of any type including subungual are uncommon in negroes. There does not seem to be any significant difference in the sex distribution, although it is slightly higher in males. It occurs much more frequently in older subjects; in one series⁸ approximately one-third were between the ages of forty and forty-nine and over one-half were above fifty. The average ages in a number of series reviewed varied from 55.9 to 58.7. The extremes appeared to be twenty-three and eighty.

History of injury is fairly frequent (i.e., 16 of 28);⁸ it is definitely higher than in other melanomatous tumors.

Gross Pathology. The nail bed has been compared to the hair follicle.⁹ In addition to certain other similarities, the nail like the follicle, which in primitive animals is a tactile organ, has a rich nerve supply with many tactile nerve endings. These are involved in the genesis of subungual melanoma.

Following injury, if this has occurred, the lesion typically begins as a paronychia. The lesion develops often as an ulcer, black and fungating, raising the nail and involving

the sulcus and matrix. The nail frequently becomes brittle and thick; it breaks or splits and becomes involved in the ulceration

ability of the fixed tumor tissue. "This gives the finished frozen section a rather bedraggled appearance due to the falling



FIG. 1.
FIGS. 1 AND 2. There is a mucus-like degeneration of the tissue.

tive and granulative process. A pathognomonic coal-black border is nearly always present along the involved edge of the nail. The tumor seems to be independent of the skin, growing from beneath and displacing the eponychium upward. With ulceration pigmented streaks may appear in the skin about the tumor. Dressings may be stained darkly from the exuded serum. Like melanotic urine, it becomes brown on standing. Pigment may be absent.

Growth is characteristically slow, spreading to the regional nodes in months; it may be rapid. The popliteal and cubital nodes are skipped usually; metastases in the inguinal and axillary regions may be sluggish in growth and extension. Inevitably rapid metastasis, probably by way of the blood stream, takes place to distant organs. The condition is then beyond treatment. Pain is never conspicuous.

Microscopic Pathology. This is varied and difficult. The tumor cells may be of any size or shape. Two types predominate: (1) spindle, which are deeper staining with fewer mitotic figures and more pigment, and (2) polygonal or spherical with a characteristic alveolar arrangement.⁸

Pigmented tumors may give rise to non-melanotic metastasis and the reverse is said to be true.³

Newell comments on the extreme fri-

apart of the tumor tissue when the section is thawed."

DIAGNOSIS

This is the critical point in the fate of the patient with subungual melanoma. The lesion occurs on a visible and prominent part of the body. It attracts attention early and it fails to respond to the casual treatment to which it may be subjected. The patient will, therefore, under ordinary circumstances, seek medical aid at a reasonably early stage in the condition while fair prospects of cure still obtain.

Any lesion about the nail in the middle aged, particularly if it is persistent, ulcerative and pigmented, should suggest subungual melanoma.

In the differential diagnosis Pack and Adair⁹ have mentioned paronychia, pyogenic granuloma, onychomycosis nigrescens, subungual hematoma, primary syphilitic chancre of the finger, gangrene of the toe, Dupuytren's exostoses, subungual fibroma, subungual keratosis, subungual epithelioma, subungual angiosarcoma (Kaposi's disease), subungual tumors of the glomus and metastatic tumors of the nail bed.

Helpful in differentiation of subungual melanoma is the elicitation of a careful history, particularly regarding injury, possible

evidence of syphilis or diabetes, and the evolution of the local condition including the possibility of foreign body and the rate

two weeks when there is gross evidence of metastasis, and in six weeks if the dissection is considered prophylactic.

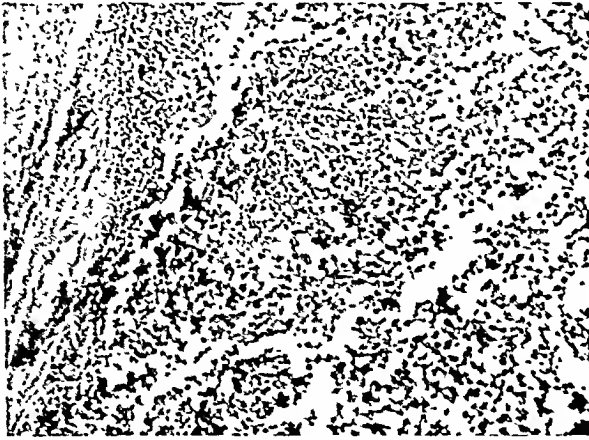


FIG. 3. A section showing the cell detail of the involved inguinal gland.

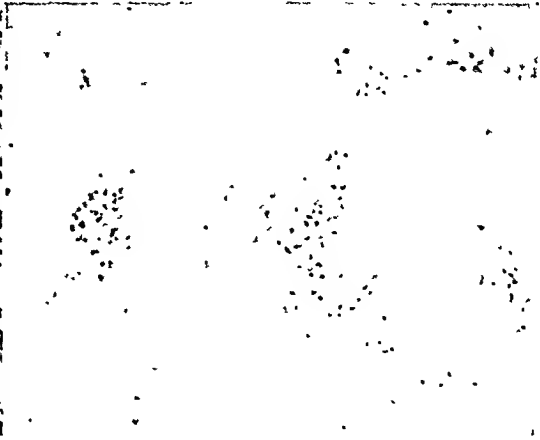


FIG. 4. Becker's stain shows the blackened pigment inside the cells.

All photomicrographs are taken at an approximate magnification of 75 diameters.

of growth. General physical examination including serology and urinalysis is of obvious importance. The appearance of the lesion, particularly regarding location and pigment content, rupture of the nail and the radiosensitiveness may be suggestive. X-ray examination, examination of the nail scrapings in potassium hydroxide solution or various culture media and biopsy are important, especially in some cases. The condition of other nails should be taken into consideration since the fairly common onychomycosis nigrescens usually involves more than one. Coexistence of the two diseases may occasionally have to be considered.

TREATMENT

Pack and Adair state, "All reported cases of subungual melanoma have been treated by surgical intervention. Malignant melanomas of all locations are notoriously radio-resistant and those located in the nail bed are doubly so because of their situation."

Amputation should be considered an emergency. Because of the high incidence of metastatic implants in apparently innocent regional glands, the routine removal of these glands has been recommended. Lymph-node dissection follows in one to

PROGNOSIS

The prognosis depends upon the metastasis to regional lymph-nodes. The percentage of cures for subungual melanoma is higher than for melanoma of any other location due to the slow rate of growth, the late period of dissemination and the location at the the terminal ends of the phalanges.

Pack¹⁰ has described results of treatment, presumably primarily surgical, in sixteen patients. In ten cases with node involvement there were two five-year survivals free from evidence of recurrence (20 per cent). In the entire group there were four five-year recoveries (25 per cent), one with recurrence. While this is not proposed as representative of the results of surgical treatment of cases generally, fourteen of the patients having had previous treatment elsewhere, it compares with the results obtained in twenty-six cases¹⁰ of melanoma of the hands and feet (not all subungual) with node involvement treated with radiation alone. There were two living without clinical metastatic melanoma, both less than three years. There were five cases which fulfilled the criteria of five-year cures in an

analogous group of thirty-five patients treated by dissection of the inguinal glands.

CASE REPORT

The patient, a fifty-one year old farmer, first seen in November, 1938, presented a right great toe the medial one-third of which was brownish pigmented. The involved nail was surrounded by a small swollen inflammatory area. It had been developing over the course of two or three months and the patient stated that it might have been stepped on by stock on two or three occasions. With a tentative diagnosis of paronychia, the involved one-third of the nail and adjacent inflammatory area were excised. The tissue was not examined.

After apparent recovery he was seen again in July, 1939, at which time he stated that two months previously he had noted enlargement in the right inguinal region and progressive pigmentation of the remaining nail. There was, in addition, some periungual inflammatory reaction. At this time the nail and its matrix were removed at the hospital and through an inadvertency the tissue was not examined by the pathologist. Six weeks later the involved inguinal lymph tissue was removed. It was a fluctuant mass which when opened was found to contain a mushy grayish material. The pathologist's report follows:

"The specimen consists of a mass from the inguinal region measuring 5 by 2½ by 2 cm. The mass apparently consists of a conglomerate mass of nodes which are fused together. The cut surface reveals a soft grayish tissue, the center of which is partially hemorrhagic and filled with a brownish hemo-purulent exudate.

"*Microscopic* sections of the lymph node reveal a thin strip of lymphoid tissue within the capsule of each node. The entire center of each node is formed of masses of cells which in some instances are supported by a very thin fibrous stroma and in other areas seem to lie free in a mucoid-like tissue. These individual cells have large vesicular nuclei and rather large nucleoli. The cytoplasm is not increased in amount, yet in a majority of the cells the nucleus is pushed to one side, giving the cell a signet ring appearance. The cytoplasm of these signet cells, however, is thick and granular instead of being clear. Muci-carmin stains show some redness in the cytoplasm of these cells, but previous experience with this stain

makes me doubt whether this alone can be taken as absolute evidence of the presence of mucus. The clear mucus-like substance between the cells and in some of the more broken down areas does not take the Muci-carmin stain very well.

"These cells occasionally contain a dark brown pigment occurring in clumps or fine granules. This pigment is very scarce in amount, but does not react for iron and does blacken with silver nitrate.

"The peculiar appearance of these cells and the presence of melanin would make one think that the tumor is a malignant melanoma. Against this diagnosis is the fact that the tumor cells are small; there are no mitoses present, nor giant cells, and there is still the question of the presence of mucus. If mucus is present, it would seem to me to be the result of a peculiar degenerative change in the cells because these cells do not have the typical appearance of mucus producing cells.

"Against the diagnosis of simple lymphadenitis is first, the absence of any evidence of inflammation as far as polymorphonuclear infiltration is concerned; second, the presence of melanin; and third, this peculiar mucus-like degeneration of the cells.

"*Opinion:* metastatic melanopithelioma of the lymph node."

Careful review of the patient's medical history and a careful repetition of the physical examination including the blood Kolmer and Kline, a routine blood count, urinalysis, and x-ray of the chest were negative. At this time the patient was apprised of the situation and amputation of the toe with a more radical resection of the regional inguinal lymphatics was recommended. The patient underwent examination elsewhere and x-ray treatment was recommended. He was given a course of x-ray treatment over the inguinal region and, although there are still a number of palpable nodes along the inner thigh and in the inguinal region, there has been no evidence of further progress or metastasis.

CONCLUSION

Subungual melanoma is a condition which is seldom seen but which should constantly be kept in mind in dealing with diseases of the nail and periungual structures. Early recognition and adequate treat-

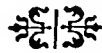
ment of the condition provides the best prognosis in this particular type of the highly malignant melanomas.

A case of subungual melanoma is reported, the only one in 18,752 new admissions in a general hospital.

Acknowledgment is made of the pathologist's report by Dr. James E. Kahler who also supplied the photomicrographs.

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. . . all tumors of the bronchi are not benign. Unfortunately for mankind, cancer of the lung is a relatively common disease. In these cases the bronchoscope has afforded the only means of positive diagnosis at the early stage in which cancer can be cured.

From—"The March of Medicine"—New York Academy of Medicine (Columbia University Press).

OSTEOID OSTEOMA OF THE FEMUR

REPORT OF A CASE

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OSTEOID osteoma, described originally by Dr. Jaffe* of New York, is probably a fairly common lesion. In reviewing my surgical experience I have the impression that I have operated upon and cured probably a dozen or more patients with this pathological condition in various parts of the skeleton, under the diagnosis of sclerosing osteomyelitis or Brodie's abscess, which actually were osteoid osteomas. In each of these cases there was a central rarefied area, usually about the size of a dime, surrounded by a variable zone of sclerotic bone. I always expected to find pus in the porotic area, but seeing only soft or granular tissue, usually sterile on culture, assumed that the area contained infected granulation tissue which had become walled off, and that the inflammatory process had not progressed to the stage of suppuration. Dr. Jaffe's very thorough studies of this subject have convinced him and many others that the lesion under consideration is not inflammatory at all but neoplastic. The case herein described is reported because it is typical of osteoid osteoma for the following reasons: first, as in many similar instances the lesion was considered preoperatively by a number of surgeons as a low grade osteomyelitis; second, the clinical features including the history, the course of the illness, the symptomatology and the roentgenographic findings coincide with those described by Dr. Jaffe as common to this pathological entity; third, the gross morphological changes in the femur revealed at operation are characteristic of this lesion; and fourth,

the histopathological examination demonstrated a central nidus of osteoid tissue surrounded by a zone of perifocal sclerosis and a complete absence of any inflammatory tissue.

CASE REPORT

Robert P., twenty-four years old, referred by Dr. Louis Shapiro of Paterson, New Jersey, consulted me on April 12, 1939, for swelling and pain in the right thigh and an inconstant limp. The patient had had the usual diseases of childhood from which he recovered without any residual defects. He is supposed to have had infantile paralysis at ten years of age and some cerebral disease previously, but neither illness has left any recognizable physical impairment. About four years previous the patient noticed an insidious onset of pain in the middle of the right thigh. He recalled no specific trauma. The pain continued and recently became aggravated. A noticeable swelling of the thigh appeared about two years later at which time a biopsy was performed in another city and, although a diagnosis of osteomyelitis was made, no further surgery was undertaken. It was manifestly appreciated that the osteomyelitis was atypical. The pain in the thigh was never intense and did not interfere with his daily routine as a student in college, or later as an instructor in one of our universities. There is no record of the rate of increase of the tumefaction of the thigh.

The physical examination was negative except for the right thigh which presented an enlargement of its middle third with tenderness to pressure over the outer surface at the level of the greatest swelling. The tenderness was present only on deep pressure. The soft tissues of the thigh felt normal, but the femur was distinctly thickened. An x-ray film (Fig. 1) showed a marked thickening of the cortex on the outer surface of the femur over an area of about four inches in the vertical diameter and,

* JAFFE, HENRY L. Osteoid-osteoma. A benign osteoblastic tumor composed of osteoid and atypical bone. *Arch Surg.*, 21: 5, 1935.

at its greatest width, two inches in the horizontal diameter. The lesion began a little below the lesser trochanter and extended down-

over the outer aspect of the right thigh. The middle of the incision was opposite the most sensitive part of the thigh. The deep fascia

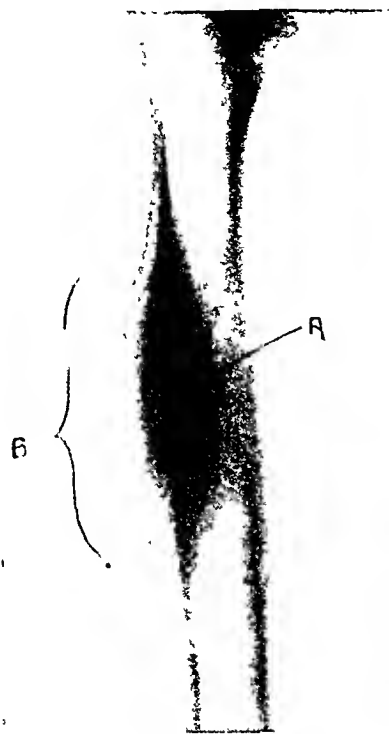


FIG. 1. Roentgenogram of right femur. A, focus of osteoid osteoma; B, area of sclerotic bone enclosing the osteoid osteoma.

ward along the shaft. Within this area there was a central rarefaction (Fig. 1 A), irregularly oval, one-half inch long and one-fourth inch wide. The rarefied focus corresponded to the region of greatest tenderness.

We were manifestly dealing with a chronic lesion of the femur which was causing pain and disability, and which required and was fortunately susceptible to surgical extirpation. The diagnosis lay between a localized, walled-off infected process, (a Brodie's abscess) and an osteoid osteoma. The ordinary chronic osteomyelitis was out of question for the following reasons: first, because the symptoms were far too mild; second, the lesion was very limited considering the duration of the illness; and third, the x-ray films showed none of the changes, such as irregular thickening of the entire width of the shaft with areas of rarefaction and sclerosis, laminae of new bone and sequestra, that are classical for chronic suppurative osteomyelitis.

Accordingly the patient was operated upon June 27, 1939. A six inch vertical incision going directly through the old biopsy scar was made

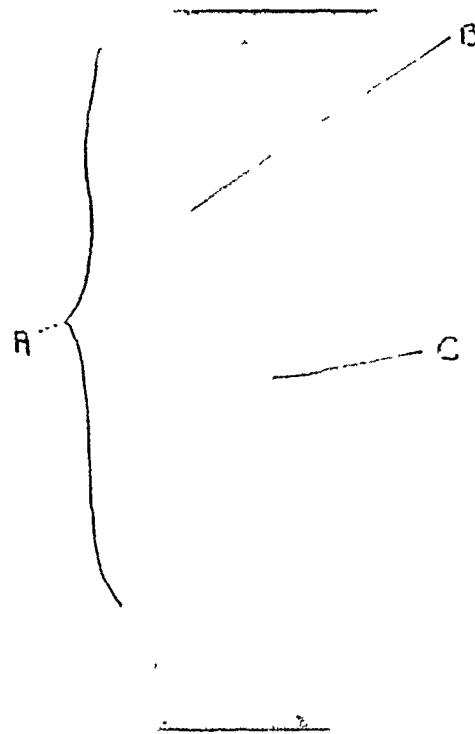


FIG. 2. Postoperative roentgenogram. A, area of operation from which most of the newly formed bone, including the osteoid osteoma, was removed. Note that there is still left a considerable amount of cortical bone, B, where the lesion existed. The medullary cavity, C, is patent and uninterrupted; this is not clear in this reproduction but is evident in the original film.

and vastus lateralis were incised vertically and retracted, exposing the femur which presented a fusiform swelling over an area of at least three and one-half inches in its vertical diameter. The periosteum was normal in appearance and thickness. It was incised and reflected backward exposing the femur, the surface of which was rough only over the widest part of the enlargement. With a chisel the outer surface of the femur was removed in one mass. This mass was about four inches long, two inches in its anteroposterior diameter and one and one-half inches in its transverse diameter. When this mass was removed, there was found in the middle on its inner surface an excavated area about as big as a dime, filled with soft granular tissue. On the cut surface of the femur was found an area of erosion within the cortex, corresponding to the softened area in the removed mass, in which there was similar

soft granular tissue. A bit of this was taken for a culture. The entire softened area was thoroughly curetted and the tissue saved for

promptly and has not returned. I have seen him several times since the operation. He has returned to work and considers himself well

FIG. 3.



FIG. 4.

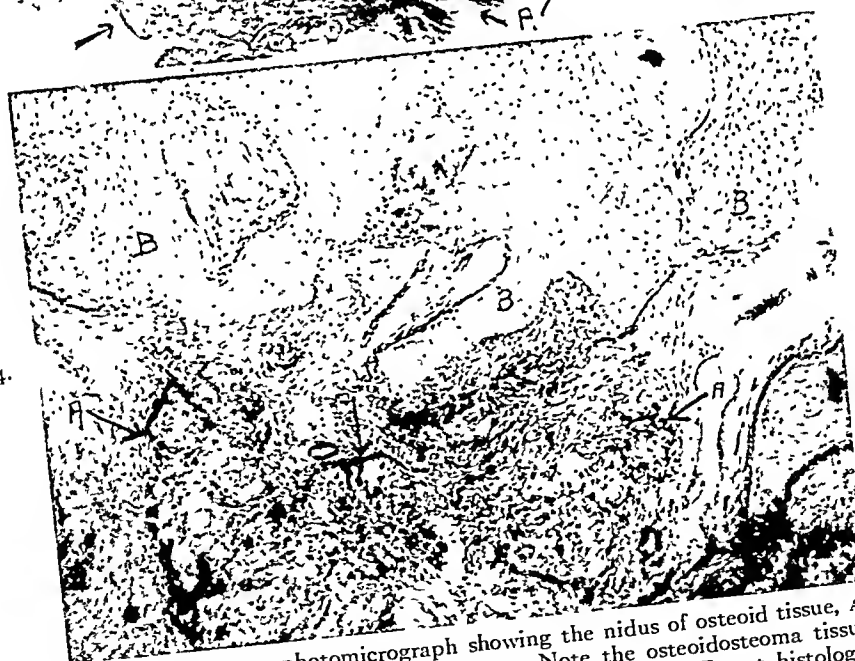


FIG. 3. Low power photomicrograph showing the nidus of osteoid tissue, A, and the surrounding sclerosed bone, B. Note the osteoidosteoma tissue delimited by the arrows. This tissue is clearly of a different histologic nature from the overlying cortical lamellar bone. Detailed examination of the osteoidosteoma showed no evidence of inflammation in or about it.

FIG. 4. Photomicrograph of a higher power than that in Figure 3. Note the calcifying osteoid tissue, A, and the perifocal sclerosed bone, B.

pathological examination. No attempt was made to enter the medulla. The bone was made as smooth as possible with chisel and file and the wound was closed in layers without drainage.

The patient made an uneventful and rapid recovery. The pain in the thigh disappeared

(October 1939). The culture of the granular tissue removed from the focus in the femur was sterile.

An x-ray film (Fig. 2) made about one month after the operation shows that the lesion was completely excised. There is still some thickening of the shaft of the femur. The medullary

cavity appears undisturbed. According to the roentgenographic film and the findings at operation the focus of disease was entirely within the cortex or at least within cortical bone. The histopathology is well illustrated in the photomicrographs. (Figs. 3 and 4.) Figure 3 is a low power photomicrograph which shows clearly the nidus of osteoid tissue and the surrounding sclerosed bone.

The tissue removed at the operation was examined by Dr. Jaffe who concluded that the lesion was an osteoid osteoma. Formerly, Dr. Jaffe believed that the primary lesion in osteoid osteoma always originated in cancellous bone and then became encased in sclerosed or cortical bone. His more extended experience has convinced him that the osteoid nidus may also arise in cortical bone.* This would seem to be so in the present case in which the focus of disease is entirely within the cortex of the femur.

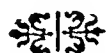
The detailed histological examination of the tissue removed in this case, as in every other in Dr. Jaffe's experience, did not show any evidence of inflammatory tissue, so that this lesion is definitely not of an inflammatory nature and has nothing in common with such processes as Garré's

*JAFFE, HENRY L. and LICHTENSTEIN, LOUIS. Osteoid-osteoma. *J. Bone & Joint Surg.*, 22: 645. 1940.

sclerosing osteomyelitis or Brodie's abscess. Osteoid osteoma is a neoplasm composed of osteoid and atypical bone. It is benign in character because: (1) it is distinctly encapsulated; (2) it is not invasive; (3) it does not recur after excision; and (4) it does not metastasize.

SUMMARY

There is here reported what is considered to be a typical case of osteoid osteoma affecting the right femur. The classical characteristics include the following: The patient was a young adult. The illness appeared insidiously four years ago and progressed slowly. The main subjective complaint was mild but constant pain. The roentgenogram showed a large area of newly formed sclerotic cortical bone within which was a small rarefied focus of osteoid tissue. At operation the osteoid lesion was found to be limited to the cortex, that is, the periosteum was normal and there was no invasion of the surrounding soft tissue or the medullary cavity. The histological picture is typical of the lesion described and considered by Dr. Jaffe as a benign tumor which he has called osteoid osteoma. The patient has been completely relieved by the removal of the diseased area from the femur.



CONVULSIONS ASSOCIATED WITH GENERAL ANESTHESIA: "ETHER CONVULSIONS"

REPORT OF A CASE WITH FINDINGS AT AUTOPSY

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CASE REPORT

R. W., a twenty-three year old white man, was admitted to the Evanston Hospital on July 23, 1940, at 6 P.M. On July 21, two days before admission, he was doubled up by a severe pain in his right side. This was followed by severe pains the following day which confined him to bed because the pains were made worse by standing and walking.

Physical examination revealed a well nourished, well developed, muscular young man. The head, chest, neck and extremities were essentially normal. Localized tenderness was present over the lower right abdominal quadrant, most marked over McBurney's point. There was also definite tenderness in the right flank. The mouth temperature was 100°F., the pulse rate 100, the respirations 22. The leucocytes were 17,000 and the erythrocytes were 5,370,000 per cu. mm. Except for two or three leucocytes in each high power field of a centrifuged specimen, urinalysis was normal.

Acute appendicitis was diagnosed. A hypodermic injection of morphine sulfate $\frac{1}{4}$ grain and atropine sulfate $\frac{1}{150}$ grain was given thirty minutes before going to the operating room. Ethylene-oxygen-ether mixture by closed method was administered. His pulse rate was 90; the systolic blood pressure was 120 mm. Hg. The operation began eleven minutes after the anesthetic was started. The patient seemed difficult to anesthetize.

A McBurney muscle splitting incision was made. The appendix was bound down to the cecum by several firm adhesions and there was considerable angulation of the appendix in its middle but it did not seem grossly inflamed. There was no free fluid in the peritoneal cavity. Eighteen or twenty inches of the terminal ileum was normal. The appendix was removed. When the peritoneum was about two-thirds

closed, the patient was seized with a series of clonic contractions. In the beginning they were confined to the muscles of the face and neck. They quickly increased in severity to involve the trunk and lower extremities. Within two or three minutes the convulsions made difficult the completion of the operation. The microscopic diagnosis was chronic fibroplastic appendicitis.

At the time of the first convulsion the operation had been in progress sixty minutes and the anesthetic seventy-three minutes, including the time of the induction. The closure of the operative incision was continued and consumed nine minutes, during which time the anesthetic was stopped and intravenous medication started. Calcium gluconate, 10 gr., was given by vein. A few minutes later five more grains was administered. This had no effect on the convulsions. Sodium luminal, 2 gr., was given subcutaneously without apparent effect. About fifteen minutes after the onset of the convulsions the rectal temperature was 105°F. In spite of tepid sponging it rose to 107°F. The patient was placed in an ice pack; an ice water enema was given. About one hour after the onset, the severity of the convulsions had slightly decreased. They ceased after the intravenous administration of 3.75 gr. of sodium amytal. The rectal temperature was 102°F. The patient was given intravenous saline solution (3.25 Gm. per liter). One and seven-eighths grains of sodium amytal was given to control recurring convulsions. Three hours after the onset of convulsions the systolic blood pressure fell to 60 mm. Hg. The lower extremities were wrapped and elevated. Two cc of coramine and intravenous fluids elevated the systolic blood pressure within the next fifteen minutes to 118 mm. Hg. His pulse rate varied from 140 to 160; the respiration rate varied from 30 to 50. Perspiration was practically

absent at the height of, and subsequent to, the attack. The urinalysis on the first postoperative day revealed the presence of albumin (four plus) and a few erythrocytes. The blood count revealed 15 Gm. of hemoglobin (92.4 per cent); 5,270,000 erythrocytes; and 22,500 leucocytes per cu. mm. The differential blood count was: polymorphonuclear leucocytes 83; staff forms 10; lymphocytes 6; monocytes 1. Biochemic results were: nonprotein nitrogen 33.3; chlorides 485; calcium 8.97; carbon dioxide combining power 45. On the third postoperative day the nonprotein nitrogen was 42.84; glucose 90; chlorides 491; carbon dioxide combining power 48. The report of the spinal fluid examination was Ross-Jones trace; Pandy positive; glucose 82. The fluid was clear and not under increased pressure. Supportive treatment consisted of intravenous fluids and adrenal cortex extract. Sodium bicarbonate and lactate Ringer's solution were given to combat acidosis. Recurring convulsions were treated with sodium amytal. He had involuntary bowel movements. Catheterization was necessary.

Twenty hours after the convulsions the patient was seen by Dr. Lowell D. Snorf. His opinion was: "The heat regulation center has been disturbed either by hemorrhage, embolism, or edema." Encephalitis was also considered.

A neurological examination was made by Dr. Harry Paskind thirty-six hours after the onset of convulsions. The patient was in profound stupor. There was no response to pin pricks. The ankle jerks were present and about equal. The knee jerks were present and fairly brisk. The left arm jerks were brisk. (The right arm was not examined because fluids were being administered in the cephalic vein.) No pathologic reflexes were present. The cremasteric and abdominal reflexes were absent. No facial asymmetry was present. The patient did not respond to external stimuli.

The patient died on the seventh postoperative day.

Necropsy was performed four hours after death. The male body was well developed and well nourished. The body length was 170 cm.; the weight, 75 kilos. Rigor and livor mortis were present. The conjunctivae and sclerae were normal. The round right pupil was 5 mm. and the round left pupil was 4 mm. in diameter. Oral hygiene was excellent. The recently shaven, flat abdomen was two fingers' breadth below the level of the symmetrical chest. A

recent, healing, sutured McBurney incision, 8 cm. long, was present. Peripheral edema was absent. The vermiform appendix was absent. Its inverted stump was well healed. One hundred fifty milliliters of fibrin-flecked, amber fluid was in the left and 50 ml. of a blood-tinged fluid was in the right pleural cavity. The right heart border was 5.5 cm. and the left heart border was 12 cm. from the midsternal line. The cardiac apex was located in the left sixth intercostal space in the anterior axillary line. The smooth pericardial sac contained 50 ml. of a clear, amber fluid. The right cardiac chambers were dilated.

The thymus was grossly replaced by fat tissue, although microscopic examination of fat tissue taken from the region of the thymus gland revealed a few atrophic lobules of thymic tissue containing degenerated Hassall's corpuscles, separated by, and surrounded with, adult fat tissue.

The thyroid gland weighed 16 Gm. The small lobes were connected by a narrow isthmus. The acini were composed of small and medium-sized follicles lined with cuboidal to flat epithelium. A moderate amount of homogeneous eosinophilic colloid was present. Slight interstitial fibrosis was noted.

The heart weighed 395 Gm. The epicardium was normal. The right chambers were engorged with clotted blood. The left ventricle was 17 mm. and the right ventricle, 4 mm. thick. The circumference of the valve rings were: aortic, 55 mm.; pulmonic, 75 mm.; mitral, 100 mm.; tricuspid, 140 mm. The valvular and mural endocardium was intact. The firm, brown-red myocardium was free from gross scars. The coronary vessels were normal. Microscopically the myocardium exhibited slight change. Interstitial edema, slight round cell infiltration and engorgement were present.

The aorta displayed the normal elasticity. Grossly its intima was smooth and the wall thin. No changes were noted in its major branches. The circumference of the aorta was as follows: Directly above the diaphragm, 40 mm. at the celiac axis, 37 mm. A slightly swollen intima, beneath which were narrow, scattered, irregular areas of slightly myxomatous degeneration, were seen in microscopic sections.

The right lung weighed 1,240 Gm. Gross and microscopic examination revealed a moderate fibrinous pleuritis, confluent bronchopneumonia, congestion and edema.

The left lung weighed 910 Gm. This lung was more severely affected. There was a heavy fibrinous pleuritis. In addition to the congestion, edema and acute confluent bronchopneumonia, there was an unresolved pneumonia which in some areas was beginning to undergo organization. The terminal branches of the pulmonary artery in the upper lobe were thrombosed. A hemorrhagic infarct, 4.5 by 4 by 4 cm., was in the base of the upper lobe. It was undergoing central liquefaction necrosis. Subpleural petechiae were present in both lungs.

The mediastinal and abdominal lymph-nodes were succulent and revealed acute hyperplasia. Littoral cells, macrophages and polymorphs were in the sinusoids. Moderate hyperplasia was found in the abdominal nodes. The liver and gallbladder weighed 2,035 Gm. The hepatic sinusoids were moderately engorged. The gallbladder and biliary passages were normal.

The spleen weighed 160 Gm. and was in a state of engorgement and hyperplasia. The normal pancreas weighed 100 Gm.

The right suprarenal gland weighed 10 Gm and the left, 9 Gm. Except for diminished lipid content of their cortices and engorgement, they revealed no significant changes.

The right kidney weighed 240 Gm. and the left, 220 Gm. Except for considerable engorgement and slight parenchymatous degeneration, they were essentially normal. The excretory renal passages, the urinary bladder, seminal vesicles and prostate were normal.

The gastrointestinal tract exhibited moderate venous engorgement. The visceral venous system was engorged.

The osseous system, as far as could be seen, was grossly normal. The calvarium was normal.

The brain weighed 1,410 Gm. The cerebral and cerebellar hemispheres were symmetrical, uniformly firm, and enclosed in smooth, glistening leptomeninges. There was slight flattening of the cortical convolutions and the sulci were shallow. The vascular system was normal. Microscopic examination revealed the following: In some places a mild diffuse hemorrhage, undergoing early organization was seen in the pia-arachnoid. The small veins of the corpus callosum had swollen endothelial cells and were surrounded by a slight erythrocytic extravasation. Some of the blood had laked. A few macrophages containing hemosiderin were present but leucocytes were absent.

The essential anatomic diagnosis was: Bilateral confluent bronchopneumonia; unresolved pneumonia with beginning carnification; necrotic hemorrhagic infarct of the left upper pulmonary lobe; pulmonary thrombosis; dilatation of the right heart; mild diffuse hemorrhages of the pia-arachnoid; edema and perivascular hemorrhages of the brain; hypoplasia of the aorta; involution of the thymus; atrophy of the thyroid; hyperplasia of the mediastinal and abdominal lymph-nodes; status post appendectomy; healing McBurney's incision.

Dr. Arthur Weil, Associate Professor of Neuropathology at Northwestern University Medical School, re-examined the microscopic sections of the brain. The severe generalized ganglion-cell degeneration found as a result of heat stroke or hyperthermia was not observed.

Because of the possible influence of heat as a cause of the patient's convulsions, one should note that the temperature during the entire day of the operation was very high; the official temperature of the outside air as given by the Chicago weather bureau was 92°F. at 9 P.M., which was approximately the time that the operation started. Because of accumulated heat it is entirely possible that the temperature in the operating room was several degrees higher than that of the outside air.

A large number of case reports on the subject of convulsions associated with general anesthesia have appeared in the literature since 1925. Prior to that time only one author reported upon this subject.

Dr. John S. Lundy¹ published in 1937 a series of 137 cases of convulsions associated with general anesthesia reported as "ether convulsions." In his series the mortality was 18.9 per cent. Doctor Lundy writes: "The type of muscular seizure that is not of short duration may or may not be dangerous. The etiology may not be known, but in any event it seems to me that the important factors are: 1) Convulsions can probably be controlled by the use of barbiturates intravenously. 2) The most dangerous cases are those in which there is profound toxemia and, therefore, in select-

ing the anesthetic for such cases it might be better to use spinal, infiltration, or block anesthesia or avertin to produce basal anesthesia, than to use an inhalation anesthetic only."

Nearly as many theories of the etiology of convulsions under anesthesia have been presented as there are authors writing on the subject. Many suggested causative agents cover a wide and often fanciful range.

In discussing the effect of anoxia on the central nervous system and convulsions during anesthesia, Beecher² in the "Physiology of Anesthesia" states; "Damage of the central nervous system by asphyxia is swift and devastating. Its effect here takes precedence over organic damage in other regions of the body. For many years the effects of anoxemia and ischemia on the central nervous system have been studied intensively, beginning with the experimental work of Astley Cooper, 1836."

Gildea and Cobb,³ in 1930, reviewed the literature on the subject. In an extensive experimental study on cats they have determined the effects of ischemia on the cerebral cortex. "Acute cerebral anemia was produced by largely obstructing the blood flow to the cerebrum for 10 minutes. The mucous membranes of the mouth and nose immediately became pale. The animal stiffens out, then becomes limp and the reflexes usually disappear. At the same time the pulse rate increases and respiration lapses, then becomes irregular and gasping and finally ceases. At the end of from one to two minutes with cessation of respiration, the heart slows down, only to become rapid again for two to four minutes, later, as the vagus center fails, the arteries of the retina decrease in diameter. As the blood flow slows down, one can make out the red blood cells passing through the smaller vessels (we have never observed the blood flow to cease entirely except in animals in which the heart had stopped). Thus, he soon becomes an animal that is completely relaxed, usually with all reflexes absent (occasionally there is an exception) dilated

pupils, no tear secretions, depressed furrowed cornea and pallid mucous membranes in the nose and mouth. The heart is slow and the pulse is usually weak in spite of adequate artificial respiration. If the anemia is severe and sufficiently prolonged, convulsions usually appear (in 65 cats out of 90) during this period of observation. This may be preceded by clonic movements of one foot or by rigidity of the whole body. Then there is a brief period of tetanic convulsions which is likely followed by gross clonic convulsions, often involving the whole body. The first seizure may be mild and last only a few seconds, but if cerebral circulation is not restored at once, others quickly follow and they become so violent that it is often impossible to keep the cannula which maintains artificial respiration in the trachea. The usual outcome of such severe convulsions is death."

Beecher² states, "Experienced anesthetists who have had the misfortune to witness 'Ether Convulsions' will recognize that Gildea and Cobb have given unintentionally a remarkable description of this catastrophe, and possibly the explanation of its cause as well."

SUMMARY

1. A fatal case of convulsions associated with general anesthesia is reported. One hundred sixty-eight cases have previously been published.
2. The etiology of convulsions under general anesthesia is not established and the treatment is not standardized. The recommendations made by Lundy in 1937 are of interest. They are: "1. Convulsions can probably be controlled by the use of barbiturates intravenously. 2. The most dangerous cases are those in which there is profound toxemia and therefore in selecting the anesthetic for such cases it might be better to use spinal, infiltration, or block anesthesia or avertin to produce basal anesthesia, than to use an inhalation anesthetic only."

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IN the rare cases where congestive heart failure does appear for the first time or recurs following delivery, there is some severe complication to produce it.

From—"The Heart in Pregnancy and the Childbearing Age"—by Burton E. Hamilton and K. Jefferson Thomson (Little, Brown and Co.).

PRIMARY ADENOCARCINOMA OF THE JEJUNUM

REPORT OF A CASE

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AND

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PRIMARY adenocarcinoma of the jejunum, from study of clinical and postmortem reports in the literature, and eleven were women, with an average age of fifty-one years. In one-third of their cases, there was a history of car-



FIG. 1. Gastrointestinal film taken January 5, 1930, showing a defect in the jejunum, where the carcinoma was found, with a greatly dilated loop of bowel.

is a rare condition difficult to diagnose early, associated with a rather high operative mortality and grave prognosis.

Mayo and Nettrout¹ from the Mayo Clinic, prior to February 1, 1936, reported thirty-one cases of primary adenocarcinoma of the jejunum, or 0.15 per cent of all their carcinomas of the gastrointestinal tract. Twenty of their patients were men

cinoma among some blood relative of present or preceding generation. The chief symptoms were colic, anemia, loss of weight, weakness with fatigueability, intermittent periods of obstruction with vomiting, hematemesis and melena. Gastric analysis on twenty cases showed one case of hyperchlorhydria, while the remainder showed an absence or marked lowering of

gastric hydrochloric acid. The average length of life in their series was 17.6 months, although some patients lived as



FIG. 2. Photograph of gross specimen, with marker indicating point of perforation of the carcinoma.

long as seven years. They also found that x-ray studies did not help in making an early diagnosis.

Christofferson and Jacobs² reported a case with perforation of the carcinoma with operation and death. Cave³ reported three cases, which were the only reports entered in the laboratory files of Roosevelt Hospital over a period of sixty-four years.

Carter⁴ likewise reported three cases, with one patient alive and well for over a year. The same author quotes Hellstrom as giving a mortality of 43.5 per cent and a cure in only 16 per cent. Carter also states that 72 per cent of primary adenocarcinoma occurs in the first twelve inches of the jejunum. Jones and Harris⁵ have reported a case.

Mayo and Nettrout, from all available sources, estimate that over 200 cases have been reported in the literature.

The present case to be reported is the only one in the laboratory files of the New York Hospital since 1932, out of 21,340 specimens examined by Dr. N. Chandler Foot, the Surgical Pathologist.

CASE REPORT

S. B. S., a white male, age thirty-seven years, had an appendectomy at four years of age and repair of incisional hernia twenty-one years later. His father died of carcinoma of the stomach and a sister died at the age of forty-one of malignant abdominal tumor.

On October 20, 1937, the patient had four or five tarry stools and fainted. Later he vomited dark red blood. Examination six days later showed his weight to be 188 pounds; blood count showed a secondary anemia, with hemoglobin of 60 per cent; red blood cells, 3,300,000; white blood cells, 9,100. Gastric analysis showed 110 cc. free HCl 50; total acid 60. There was no occult blood at this time.

X-ray examination by Dr. Louis A. Hauser two weeks later showed a negative stomach and duodenum. The patient was placed on an ulcer regimen and did well until five months later, when he vomited a large amount of greenish, liquid material. His weight at this time was 193 pounds. Eight months after onset, there was marked abdominal distress, with bloating and gas, worse when lying down. Thirteen months after onset, the patient developed what was diagnosed at another hospital as pneumonia. He was given sulfapyridine in large doses, with recovery from the pneumonia. This was followed by recurrent nausea and vomiting. Anemia was more pronounced at this time, with a hemoglobin of 48 per cent; red blood cells, 3,000,000. A blood transfusion was given. His weight was 188 pounds. A gastric analysis at this time showed free HCl of 76; total acid 98. No occult blood was found.

The physical examination showed a mass below and to the left of the umbilicus. X-ray examination by Dr. Hauser showed a partial obstruction of the jejunum, about eight inches below the duodenum, with narrowing, a filling defect and a diverticular pocket. There was dilatation of the intestinal loop above the obstruction and narrowing of the intestine below that point.

The patient seemed to be in good condition and was admitted to the New York Hospital.

At this time, his blood count showed 61 per cent hemoglobin; 4,000,000 red blood cells, and 9,900 white blood cells, with a normal differential. Blood serology was negative.

The pathological report by Dr. N. Chandler Foot stated: "The specimen represents a segment that appears to be from the jejunum, approximately 40 cm. in length. The proximal



FIG. 3. Photograph of slide showing tumor just beneath the serosa; enlarged about 50 diameters.

An exploratory laparotomy was performed on February 11, 1939, fifteen months after the acute onset of his symptoms.

Under preliminary avertin and ethylene gas anesthesia, the abdomen was opened through a five inch upper left rectus paramedian incision. A large, hard mass, approximately three inches in diameter, was found encircling the jejunum at a distance of six to eight inches from the duodenojejunal junction. There were enlarged regional mesenteric nodes, but no evidence of metastases to the liver or other organs. Approximately eighteen inches of the jejunum was resected, together with all visible and palpable nodes, down to the root of the mesentery. An end-to-end anastomosis was done, with aseptic technic. The mesentery was repaired by interrupted sutures.

portion is dark red in color, measures about 22 cm., the distal portion about 18 cm., and of normal color. At the junction of these, there is a double ridge of stony-hard tissue, which surrounds the gut with a most extraordinary double ruff, between the lips of which there is a deep cleft, almost as though it had been ploughed out, measuring 1.5 cm. in depth and 1 cm. in width. Completely surrounding the gut like a garter on the outside, there is a scar corresponding to this area and entirely infiltrated by tumor tissue, which is stony-hard. At the point where the double ruff impinges on the mesenteric border of the open gut, the gutter between the two ridges communicates through an opening with a diverticulum or an abscess cavity, approximately 4 cm. in diameter, which is covered by fatty mesentery and

apparently lined by continuation of the tumor tissue. This has been opened, so that its contents have been evacuated; presumably, it contained necrotic tissue and blood. In the mesentery, there are several enlarged nodes, most of them quite close to the gut. These nodes show no tumor infiltration, are large, soft and pale angry red.

"Microscopic examination reveals an unusual type of carcinoma of the small bowel. The metaplastic epithelial cells are scattered throughout, forming an adenomatous type of growth. The acini are smaller, but otherwise similar to those found in rectal carcinoma. The malignant cells are very infiltrating and are penetrating in all parts of the section. The penetrating epithelial cells are in the form of very small acini. The mucosa of the small bowel is replaced by slough.

"Pathological Diagnosis: Adenocarcinoma of the Jejunum."

Postoperative Course. A Wangensteen suction apparatus was attached to a tube, passed through the patient's nose into the stomach, and was left in place for five days. The patient was placed on a postoperative intestinal resection regimen, with adequate intravenous glucose therapy and increasing amounts of liquids by mouth after the first twenty-four hours. There was no vomiting and an entirely uneventful recovery resulted. He was allowed up on the twelfth day and home on the fourteenth postoperative day.

Follow-up. On May 9, 1939; three months after operation, x-ray examination showed a negative stomach, duodenum and jejunum. On October 10, 1939, eight months postoperatively, x-ray examination was still negative. At the present writing, now twenty-five months postoperatively, the patient is still

symptom free, with a normal blood count. His present weight is 191 pounds.

SUMMARY

1. Primary adenocarcinoma of the jejunum is rare, and makes up approximately 0.15 per cent of all gastrointestinal carcinoma.

2. Early diagnosis is difficult, but the condition should be suspected in obscure gastrointestinal cases showing colic, anemia, loss of weight, weakness, intermittent obstruction with vomiting, hematemesis and melena, and in which no definite lesion can be demonstrated by x-ray in other parts of the gastrointestinal tract.

3. Operative mortality is high and ultimate prognosis poor.

4. A case is reported which was carefully observed and x-rayed, and which did not come to operation until fifteen months after onset of symptoms. Resection was performed, followed by an uneventful recovery, and without any evidence of recurrence at the end of a twenty-five month period.

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CASE OF AN OMENTAL CYST IN A THREE WEEKS' OLD FEMALE, CAUSING FATAL ILEUS*

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THE youngest case of an omental cyst in Horgan's review¹ is that of Schremm (1903). He reported multiple lymphogenous omental cysts in a one year old female. The youngest cases of solitary lymphogenous cysts are those of Arzela (1922), and of Lawrence (1925). Both patients were three years old.

According to Horgan, symptoms in omental cysts are caused by "pressure, torsion, traction," and he lists them as "nausea, vomiting, . . . anorexia, constipation, or diarrhea, . . . pain, dysuria, frequent micturition."

Montgomery and Wolman,² who review fifty-three cases, list the symptoms as: (1) Due to the size of the tumor, and causing diffuse or localized swelling, and abdominal distress; (2) produced by twisting of pedicle, or rupture of cyst, and simulating appendicitis, or the twisting of the pedicle of an ovarian cyst; (3) there are, incidentally, omental cysts which have been found without symptoms.

As far as we know, there is only one report of an omental cyst causing ileus. Shimizu³ reports the case of a dermoid cyst of the omentum in a forty-five year old male which had been cured. The tumor was the size of a hen's egg and was adherent to the lower part of the parietal peritoneum by a band, causing ileus, and necessitating resection of the gangrenous part of the ileum.

The latest available paper about omental cysts is that of Guernsey,¹ who reviews fifteen cases. Here the theory of postinflammatory pathogenesis is favored, while Montgomery and Wolman believe in the neoplastic hypothesis.

We can report the case of a solitary,

probably lymphogenous cyst in a three weeks old female, causing fatal ileus:

CASE REPORT

O. C., female, white, three weeks old, was admitted on July 26, 1940, to St. Elizabeth

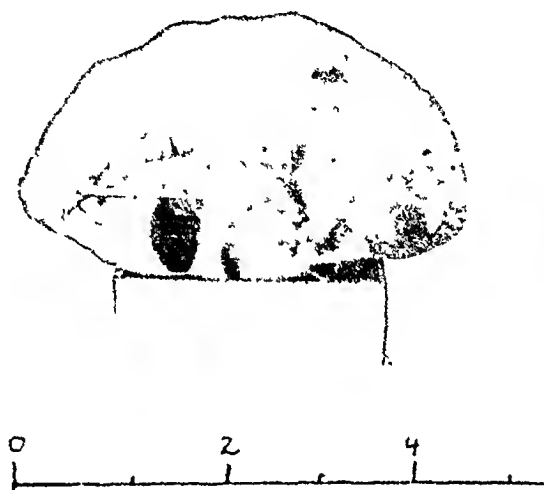


FIG. 1. Omental cyst.

Hospital, Dayton, Ohio. She had no bowel movements for five days; previously they were "not exactly normal." Three hours after the last bowel movement the child vomited. Repeated enemas resulted in small amounts of black, bloody and slimy stool. From that time on she vomited everything. On admission she was comatous, cyanotic, had a severely distended abdomen, and a purplish rash on the lower half of the body. She vomited once after admission and died two hours later.

The temperature on admission was 103.6 degrees; her respiration was 30 per minute. The red blood count was 4.2 millions, the hemoglobin 80 per cent. The white blood count was 8,000, with a differential count of 30 neutrophilic cells, 20 of them unsegmented, and 70 lymphocytes.

An autopsy was performed four hours after death. The body was well developed, fairly

* From the Pathological Department, St. Elizabeth Hospital, Dayton, Ohio.

well nourished and showed a diffuse macular skin eruption. Fat layer and musculature showed only little dehydration. The chest presented no abnormal findings.

cyanotic discoloration. The loops of the last part of the jejunum were edematous, green, opaque, friable and not distended for a length of about three inches. The neighboring part of

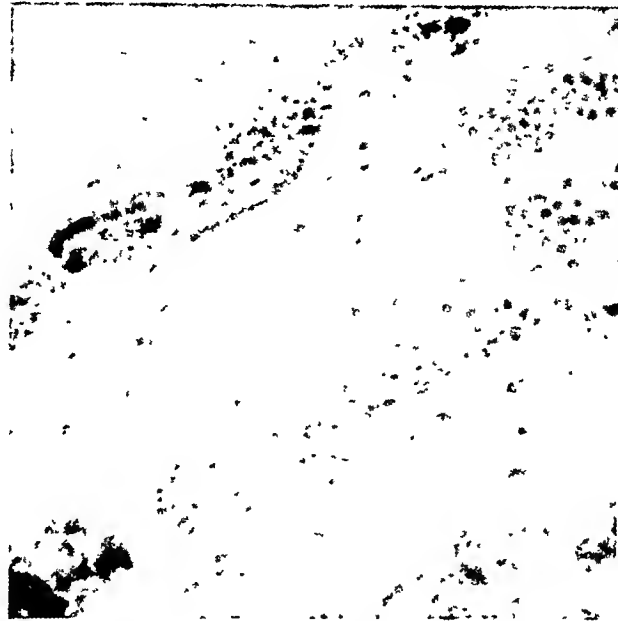


FIG. 2. Cyst wall.

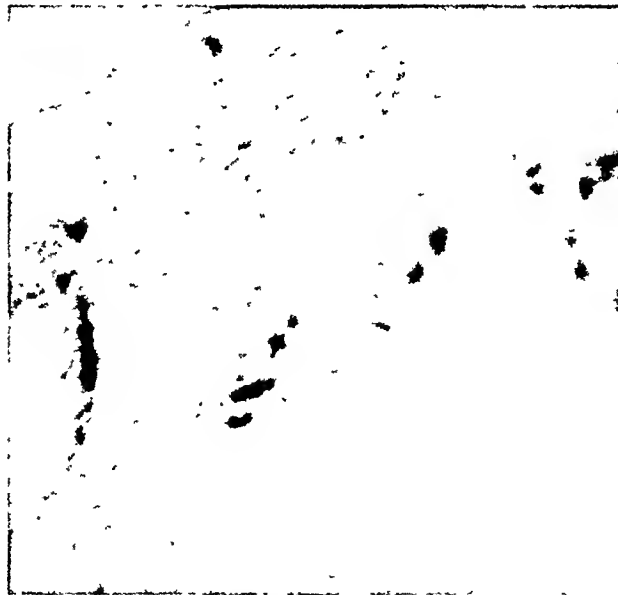


FIG. 3. Cyst pedicle.

On opening the peritoneal cavity, dark brown, foul smelling fluid exuded. The parietal peritoneum was covered with fibrinous exudate. Stomach, duodenum and the first part of the jejunum were distended. The middle part of the jejunum was also distended and showed

the ileum was cyanotic; appendix, cecum and colon presented no abnormal findings. The mesenterium of the gangrenous part of the bowel showed discoloration and a marked enlargement of the lymphnodes.

The left upper quadrant of the abdominal

cavity was occupied by an ovoid, fluctuating, thin-walled, greenish brown, smooth cyst, measuring 4 by 5 cm. in diameter. (Fig. 1.)

It was attached to the left border of the omentum by a pedicle, the cut surface of which showed soft, gray tissue, honeycombed with minute cysts. The content of the cyst was turbid, dark red, thin fluid. The wall was friable, and was composed of two layers: an outer greenish, firm layer, distinctly separated from the inner layer, which was softer, and absent in many places. It could be separated in thin, friable, lamellary structures. The inner surface of the cyst was reddish brown and finely wrinkled. The cyst pressed on the mesenteric pedicle, interfering with the intestinal blood supply.

The microscopic report stated that the cyst wall was composed of loose, fibrous tissue, without epithelial lining; there were occasional accumulations of round cells. Nearby were similarly shaped, degenerative structures. (Fig. 2.) The section through the pedicle showed a similar structure and contained numerous round and elliptical spaces, mostly empty; some were filled with calcareous material. (Fig. 3.) Occasionally they communicated with

the surface. There were occasional areas in the wall, lined with an even, finely granulated layer, which showed many beaker-like, vacant spaces, suggesting anaplastic cylindrical epithelium.

It is evident that this case does not favor the hypothesis of postinflammatory origin of omental cysts, but rather supports the congenital and/or neoplastic theory.

SUMMARY

A case of a solitary, lymphogenous omental cyst is reported in a three weeks' old female, causing fatal ileus.

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New Instruments

STERILE TRANSFER FORCEPS*

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THE customary sponge stick or utility forceps have long been recognized as a potential source of contamination of the jar and makes accidental contamination impossible. The forcep is forged† from stainless steel.

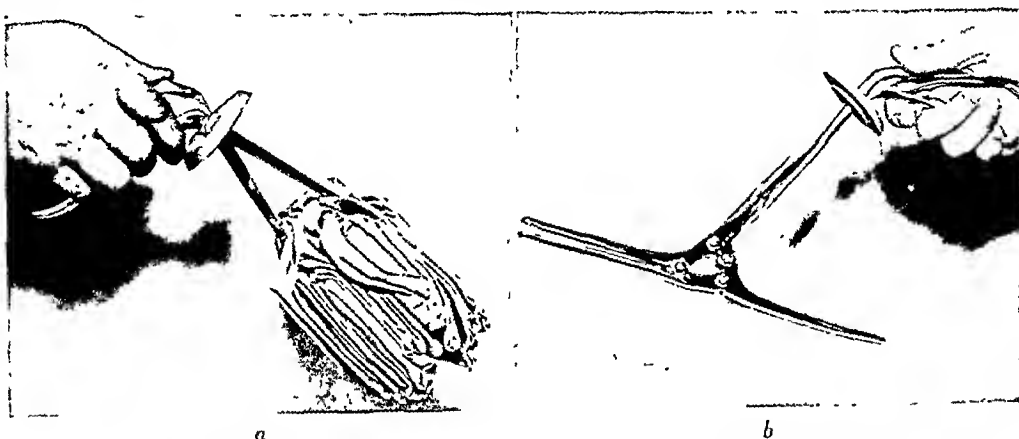


FIG. 1. A new type of transfer forceps permits the controlled transportation of sterile articles of diverse size and shape. Contamination due to the use of awkward instruments is eliminated.

sterile supplies or instruments. Various modifications have been devised to prevent evaporation of the germicide¹ or to provide a sterile lip for the jar,² but none has found wide favor, and most hospitals continue to use clumsy, makeshift instruments.

During the past five years, transfer forceps of new design have been developed at the Peter Bent Brigham Hospital. These forceps are unique because their jaws are designed to pick up and grasp firmly any instrument, milliner's needle to heavy retractor, or a sizeable package of dry goods. To safeguard the sterility of the forcep, a germicide jar was devised in which a sterile float escorts the jaws of the forcep beyond the unsterile lip of

A pistol grip handle, substituted for the finger rings of the conventional sponge stick, provides a stronger, more natural grip and is also advantageous because it projects the jaws of the forcep in the axis of the forearm—a position in which the load can be handled most easily with little chance of contamination due to misdirection of the forceps. A bump near the angle of each handle gives additional purchase for the thumb and forefinger and prevents the handle from slipping back into the palm of a large hand. The jaws are irregularly serrated transversely and have a crescentic

† Bard-Parker Company, Inc., Danbury, Connecticut, manufacturers.

* From the Laboratory for Surgical Research, Harvard Medical School, and the Surgical Clinic of the Peter Bent Brigham Hospital, Boston, Massachusetts.

cross section to afford every opportunity for them to grip cylindrical or irregularly shaped objects.

the germicide jar, effectively preventing evaporation of the germicide.

The germicide jar is molded of glass with

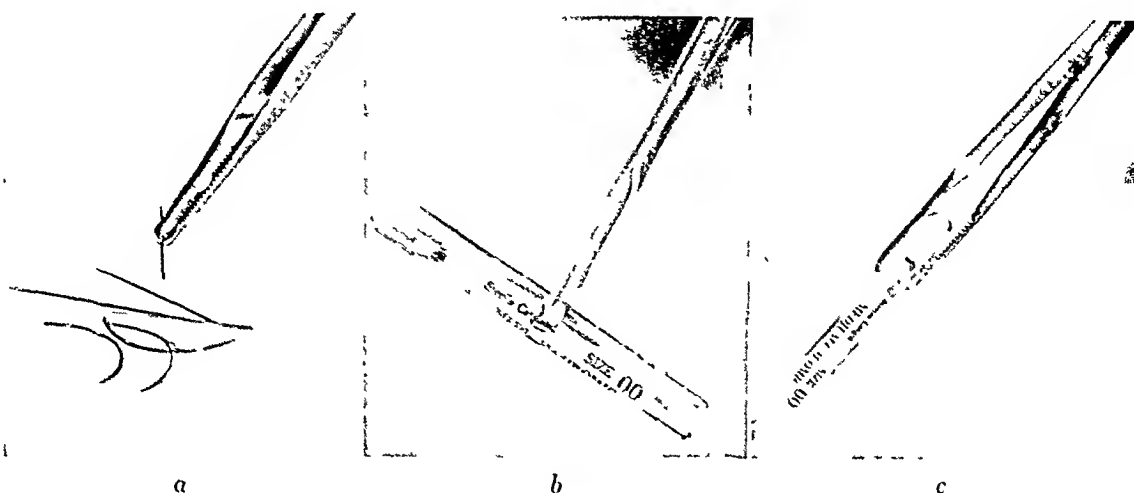


FIG. 2. The jaws are designed to pick up needles and catgut tubes as well as heavier objects.

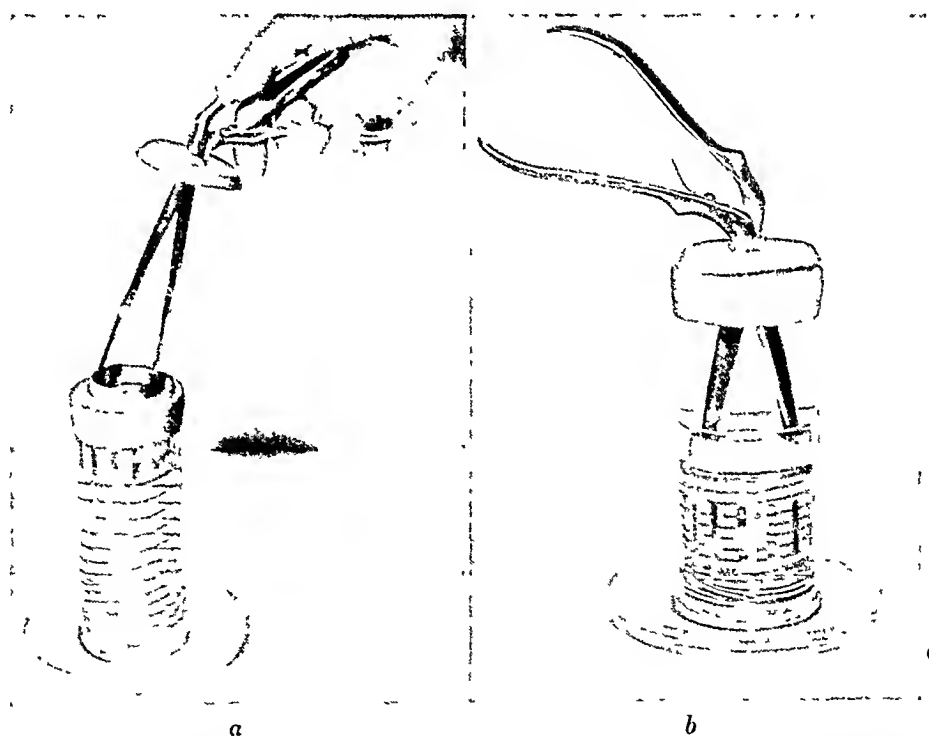


FIG. 3. The sterile stainless steel bucket escorts the jaws of the forceps beyond the unsterile lip of the germicide jar effectively, avoiding chance contamination. When the forceps are deposited in the jar, the bucket is submerged and the jar is covered to prevent evaporation of the germicide.

The legs of the forceps distal to the lock protrude through a hole in a molded disc-shaped piece of rubber which is snapped over projections of the pivot to position it permanently. The rubber forms a barrier between the handle and the sterile legs and jaws distal to it and serves as a cover for

a saucer-like base to lend stability as well as to catch spilled germicide. The jar is graduated so that the germicide³ can readily be maintained at the proper level. The upper rim of the glass jar is encased in a molded rubber ring, the upper surface of which bears a beveled lip over which the

rubber cover attached to the forceps fits snugly, sealing the jar.

The jar is fitted with a fenestrated, piston-like stainless steel bucket which is held against the rubber encasing the upper edge of the jar by a stainless steel coil spring. The rim of the bucket protrudes 1 cm. above the rubber. When the forceps are put into the jar, their jaws are automatically inserted into the bucket. The weight of the forceps is sufficient to compress the spring and submerge the bucket in the germicide. The germicide is displaced by the bucket as it sinks and flows through the fenestrations. When the forceps are

lifted, the sterile bucket guards the sterile jaws against contamination by escorting them beyond the unsterile rim of the jar.

The sterile transfer forceps described are a safe, efficient instrument for the aseptic transportation of sterile articles to the operative field.

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SIMPLY stated, a bronchoscope is a brass tube of a diameter sufficiently small to be inserted through the mouth and larynx into the windpipe, thence on down into the bronchi and lungs. The tissues in front of the tube are rendered visible by suitable electric lighting. Through the tube, accessory instruments can be inserted, such as forceps to grasp a foreign body, suction tubes for removing secretions, and so on.

From—"The March of Medicine"—New York Academy of Medicine (Columbia University Press).

A SYRINGE FOR INJECTING LIPIODOL INTO THE SPINAL CANAL

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LIPIODOL used in the spinal canal for a radio-opaque medium has in the past proved difficult to inject through the spinal needle with the ordinary hand

the barrel, and in the center of the metal cap is an opening with coarse screw thread to match the screw thread on the stem of the plunger.

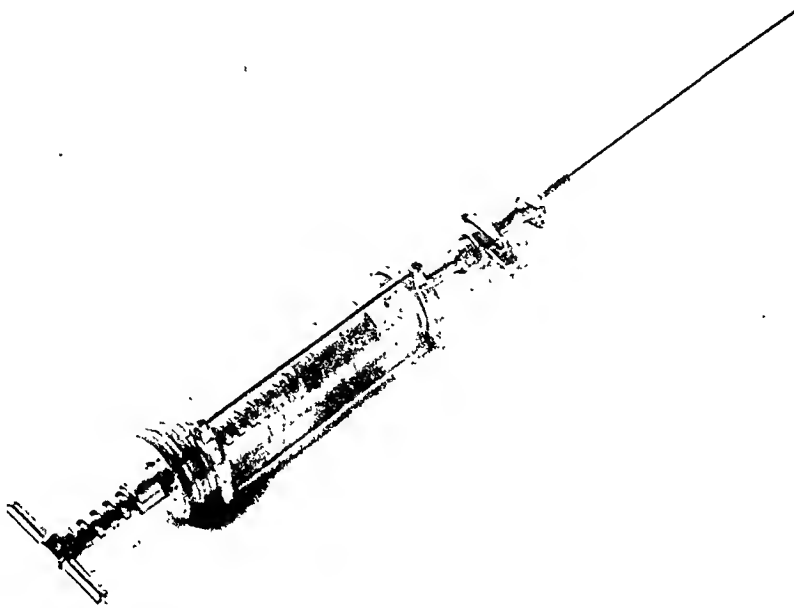


FIG. 1. Worm-drive syringe for injection of lipiodol into the spinal canal.

syringe. A portion of the opaque medium is frequently lodged outside of the dura, making it impossible at times for the roentgenologist to visualize the actual condition of the spinal canal. Furthermore, spilling of the lipiodol outside of the dura is usually followed by severe pains, whereas a clean injection is painless.

A worm-drive syringe designed by us and constructed by our mechanic has worked so satisfactorily that we wish to describe its form and operation. It has a metal plunger, the stem of which has a coarse screw thread. The glass barrel has a 10 cc. capacity, with metal attachments at each end. These metal ends are held securely by three truss rods alongside the barrel. The beak of the syringe has an adjustable attachment so that it can be firmly connected to the spinal needle. At the plunger end of the syringe is a metal cap which screws onto

After removing the plunger from the barrel, the syringe can be sterilized by boiling. Loading with lipiodol is best accomplished by placing a small hypodermic needle on the beak of the syringe and pouring the lipiodol into the barrel. The plunger is now replaced and excess air expelled. For the purpose of injection the lipiodol need not be warmed but will run more readily from the ampule if placed in alcohol of about body temperature before it is used.

Having prepared the syringe and completed the spinal puncture by a 19 or 20 gauge needle, the operator next attaches the syringe to the spinal needle. Clockwise rotation of the plunger drives the lipiodol through the needle. At the finish, the rotation should be reversed so as to suck the lipiodol from the point of the needle and not leave any of it in the tissue outside of the dura.

TREATMENT OF CEREBRAL ABSCESSES BY TRACTION DRAINAGE*

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THE treatment of deep-seated cerebral abscesses is frequently disappointing for a number of reasons. Among these

lowed to extrude itself through the usual trephine opening. In three cases of such deep-seated cerebral abscesses treated re-

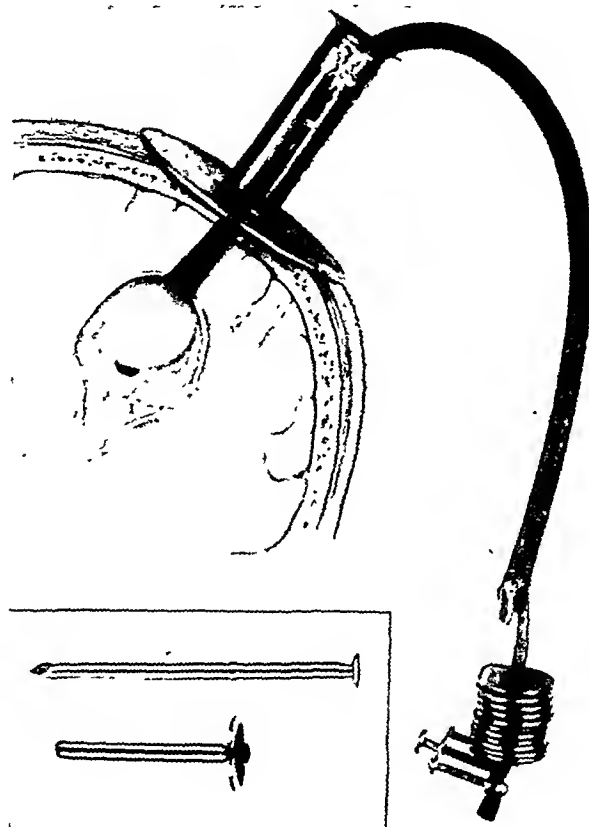


FIG. 1. Shows catheter in abscess cavity with balloon inflated; chimney in place above trephine opening to direct traction; opening in catheter for continuous drainage of pus; metal weights (100 Gm.) above clamp on tube communicating with balloon in abscess cavity. Insert shows trocar and cannula used to introduce catheter into abscess.

are: the delayed rupture of the abscess contents into a ventricle after drainage has been established, the difficulty of keeping drains in place, incomplete drainage following hour-glass collapse of the abscess wall and damage to the cerebral cortex with fungus formation when an abscess is al-

cently, a method has been employed which gives promise of overcoming some of the discouraging difficulties which have been encountered.

In each case the deep abscess was first located by introducing a blunt ventricular needle into the abscess cavity through a

* From the Department of Surgery, Wayne University College of Medicine. Read before Harvey Cushing Society, Kansas City, Missouri, May 3, 1940.

small trephine opening. The size and position of the cavity were more accurately determined after allowing some of the pus to escape and partially filling the cavity with thorotrast or air, and taking roentgenograms. After waiting as long as was thought safely possible, so that the abscess wall would become firmer, a trocar with large cannula was introduced through a nick in the dura into the abscess cavity. The trocar was then withdrawn and a special rubber catheter, which just fitted the cannula, was inserted into the cavity through the cannula. This catheter* had attached to its distal end a small rubber balloon which could be inflated through a separate fine radiopaque tube incorporated in the catheter wall. When the catheter was in place, the balloon was inflated with 15 cc. of air and the tube securely tied to prevent escape of the air. The large lumen of the catheter itself remained patent and allowed pus from the abscess to escape continuously. The metal cannula was then slipped out over the catheter, leaving the

catheter securely in place with its balloon inflated inside the abscess cavity.

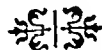
A metal chimney, three inches high, made from an adhesive tape roller, was then incorporated in a starch head dressing with the chimney directly over the trephine opening and with the catheter threaded through the chimney. A weight of 100 Gm., made up of metal washers, was attached to the free end of the catheter which hung from the chimney, thus insuring a steady traction on the abscess. Pus continued to drain from the catheter and, at the end of a week, the abscess wall in each case had been drawn to the surface of the brain.

The trephine opening was then enlarged in one case, the dura split further and the abscess allowed to extrude itself. In the other two cases the collapsed wall was allowed to remain at the brain surface with residual drainage through the sinus left after the catheter had been removed.

SUMMARY

A new method of traction drainage is described for deep cerebral abscesses, employing a special catheter with inflatable balloon attached to its distal end.

* Traction drainage catheter manufactured by C. R. Bard Company, New York.



Bookshelf Browsing

THE BIBLICAL MYTH OF THE BRAZEN SERPENT

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THE myth of the brazen serpent, one of the less familiar stories of the Bible, has been the inspiration for and discouraged by hardships and privations in the wilderness, the people in despair complained against God and

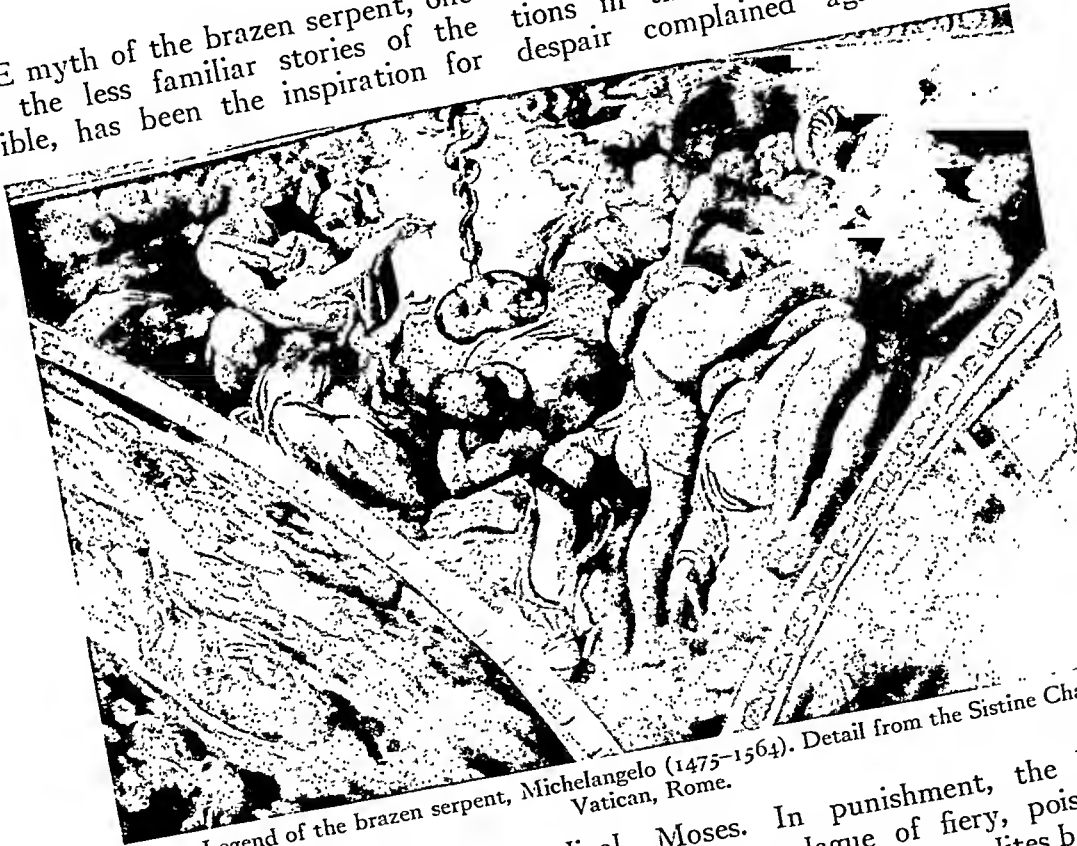


FIG. 1. Legend of the brazen serpent, Michelangelo (1475-1564). Detail from the Sistine Chapel, Vatican, Rome.

this excursion into the byways of medical history as portrayed in classical art. The legend also permits interesting speculation as to its significance in other fields, such as theology and mythology, particularly in regard to the ancient practice of serpent worship.

As related in the Book of Numbers, the incident of the brazen serpent occurred during the wanderings of the children of Israel under the leadership of Moses, following the exodus from Egypt after their liberation from bondage. Worn out

Moses. In punishment, the Lord sent down a plague of fiery, poisonous serpents. The terrified Israelites besought the aid of Moses, whose prayer for assistance for the penitent people was answered:

"And the Lord said unto Moses, make thee a fiery serpent and set it upon a pole: and it shall come to pass, that everyone that is bitten—when he looketh upon it—shall live.

"And Moses made a serpent of brass and put it upon a pole, and it came to pass, that

if a serpent had bitten any man—when he beheld the serpent of brass—he lived.”*

This curious story presents three main topics for speculative comment. Its im-

tenets of the Hebrew religion as expressed in the first three Commandments:

1. Thou shalt have no other gods before me.



FIG. 2. Legend of the brazen serpent, Tintoretto (1518-1594), Venice.

plications may be discussed from the viewpoints of theology, mythology and medical history.

Primarily one is impressed with the inconsistency of the use of an idol, which is strictly forbidden by the monotheistic

* Numbers, xxxi 8, 9.

2. Thou shalt not make unto thee any graven image, or any likeness of anything that is in heaven above, or that is in the earth below, or that is in the water under the earth.

3. Thou shalt not bow down thyself to them or serve them.

The setting up of the brass serpent, therefore, seems to constitute a direct violation of the injunction against graven

sensation of the Diety. However, even this interpretation is not entirely acceptable, as it places another power on a level with the



FIG. 3. Legend of the brazen serpent, Van Dyck (1620), Madrid.

images. Various interpretations of this story are possible. The sacrilege may in part be refuted, in that the image did not represent an alien god. However, theologians cannot quibble about the fact that even images of Jehovah were forbidden. Another possible explanation involves the concept that the brazen snake was not only a healing device but also a reminder of the grave sin committed by the skeptical Israelites in doubting the Lord, and thus a warning against further transgression. At best, this is but an evasion.

The Hebrews, as other early peoples, stood in awe of the demons of the desert. Various diseases and misfortunes were attributed to these malignant demons, which were usually identified with serpents. In this sense the serpent-image could be considered a counterspell and not a repre-

Supreme Being, or, at least, it recognizes demonology in conflict with the true monotheistic faith.

It seems incontrovertible, therefore, that the use of the serpent image was an actual variation from the rigid observance of the Mosaic Code. One may surmise that the reason for its intrusion in the early Hebrew mythology was the not uncommon practice for one religion to adopt and modify certain devices or rituals from its predecessors, particularly when long usage had firmly established them in the folklore of the people. This would apply with specific emphasis to serpent-worship which occupied an important, if not dominant, position in most of the primitive religions. As the concept of the Hebrew religion developed to a higher plane of morality the brazen serpent was discarded. This is

evidenced in the action of Hezekiah, one of the later prophets, who instituted many reforms:

"He broke in pieces the brazen serpent that Moses had made, for unto these days

The fear and reverence of the snake in many instances constituted a cult in which the snake was symbolical of a divine being.² This worship was second in importance only to sun-worship. Zwick considers the



FIG. 4. Relief on Thirteenth Century Roman Chancellory, Wechselburg, Germany.

the children of Israel did burn incense to it."^{*}

The antiquity of serpent-worship is indicated by the frequent mention of snakes in the religions of ancient peoples.¹ In various mythologies the snake was either a god or a god-symbol. Ishtar, the Babylonian Mother-goddess, was represented as the Earth-Snake. Isis, Egyptian goddess of life and healing, wore a snake headdress. Snakes were revered in Crete, Greece, Phoenicia, India and elsewhere. The dragon was the symbol of the ancient Chinese civilization. The serpent was a character in the Garden of Eden myth. Also, in the Semitic language the stem word for "snake" is the same as that for "life." Snake worship has persisted in modern times in Haitian voodooism, American Indian ceremonies and in the rituals of many savage tribes throughout the world.

* 2 Kings: xviii, 4.

universality of serpent-worship a reflection of the thoughts of most peoples that the snake possessed a deep mysterious knowledge, symbolized the soul of the universe and was a reincarnation of the Deity.³

The association of the serpent with medicine has been established as very ancient in origin, probably arising simultaneously in various civilizations. Osler, among other authorities, supports this premise: "The idea of the serpent as the emblem of the healing art goes far back into antiquity. The mystical character of the snake, and the natural dread and awe inspired by it, early made it a symbol of supernatural power. From the earliest times the snake has been associated with mystic and magic power, and even today, among native races, it plays a part in the initiation of medicine men." Also, in this connection may be mentioned the caduceus or double-serpent staff, which has some

acceptance through usage as an insignia of the medical profession. Though usually thought of as the emblem of Hermes, the

While the Biblical legend of the miraculous healing power of the serpent cannot be claimed as the origin of this symbolism, it



FIG. 5. Gobelin tapestry, Sixteenth Century, depicting legend of the brazen serpent.

Greek messenger god of commerce, the design can be traced back five thousand years to Ningishzida, the Babylonian god who also had medical attributes.^{5 6}

Our particular interest in the legend of the brazen serpent lies in its implication concerning the origin of the accepted insignia of the medical profession, the Aesculapian staff.⁷ Aesculapius, the hero-physician of ancient Greece, was deified as the patron of the art of healing about 430 B.C. The staff with the single serpent entwined was then adopted as his attribute. However, as employed in the myth of the Biblical story, the use of the serpent as a symbol of healing antedates this by seven centuries, if one accepts the approximate date of 1200 B.C. as the time of the Exodus of the Israelites from Egypt.

affords an early example of the use of the serpent as an insignia of the healing art, preceding its use by the Greeks in connection with Aesculapius, the demigod of medicine. Whether the Greeks adopted the serpent staff from the Biblical story, or as is more probable, from the earlier Babylonian source, must remain an open question.

The characters and stories of the Bible have been used as the subject of numerous paintings, many of them by famous masters. The Renaissance painters, in particular, favored biblical themes. Hardy has commented: "If the Bible has been the inspiration of countless artists during the last twenty centuries, they in turn have served merely as transmitters of this high inspiration. Each painting not only clarifies

the Bible but reflects the artist's understanding and the culture of his time."⁸

The accompanying illustrations portray the legend of the brazen serpent as conceived by various artists.⁹ We were interested in this connection to see how painters depicting the incident would visualize the serpent on the pole. The similarity of their conception to the accepted serpent-entwined staff of Aesculapius is striking.

From the viewpoints of theology, mythology and medical history, this legend has offered a field for various interpretations. Some of these, perhaps, are valid, while others are purely conjectural. Nevertheless, in a small way, it exemplifies how one can find interesting topics for investigation in subjects related to medicine but remote from the clinical or scientific fields. These collateral pursuits help maintain one's enthusiasm, stimulate the inquiring mind and enlarge the appreciation of the cultural and historical background of the profession.

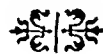
The need for a constant interest in "work by the side of work" is summarized aptly by that revered exponent of the art of medicine, Sir William Osler:

"By the neglect of the studies of the humanities, the profession loses a very precious quality. Man does not live by

bread alone. One cannot practice medicine alone and practise it early and late, as so many of us have to do, and hope to escape the malign influences of a routine life. The incessant concentration of thought upon one subject, however interesting, tethers a man's mind in a narrow field. The physician needs a clear head and a kind heart; his work is arduous and complex, requiring the exercise of the very highest faculties of the mind, while constantly appealing to the emotions and finer feelings."

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Selected Book Reviews

THE HEART IN PREGNANCY AND THE CHILDBEARING AGE*

By BURTON E. HAMILTON, M.D. AND K. JEFFERSON THOMSON, M.D.

With a Section Entitled Delivery and Obstetrical After-Care
of Cardiacs

By FREDERICK C. IRVING, M.D., F.A.C.S.

THIS excellent book, excellent from all viewpoints, should receive an enthusiastic welcome from the majority of physicians and enjoy a wide distribution. If all doctors of medicine who "take" obstetric cases would read and apply the teachings between the covers of this book, there would be a further lowering of the maternal mortality rate in this country. Also, many women with heart disease who become pregnant and are subjected to therapeutic abortion would be permitted to go to term and have babies. For based on years of observation and clinical experience, the authors' classify the various degrees of cardiac disease and tell us what types should not become pregnant, who should not be permitted to continue with a pregnancy and which ones may safely continue with a pregnancy provided they are handled intelligently.

The basis of this work was started with Dr. Franklin S. Newell who inaugurated and continued a Heart Clinic for ten years. Then Dr. Frederick C. Irving took up the work and enlarged the scope of the study of cardiacs who became pregnant. Covering a period of twenty years this work was done at the Boston Lying-In Hospital. In 1920, Dr. Newell started special services for the study of some of the complications of pregnancy, including heart diseases. At that time (1921) Sir James Mackenzie complained that modern medical knowledge of the heart was, in general, poorly understood and taught. The main object of Mackenzie's work was "to direct the attention of obstetrical physicians to the newer knowledge." He hoped this sub-

* Boston, 1941. Little, Brown and Company.

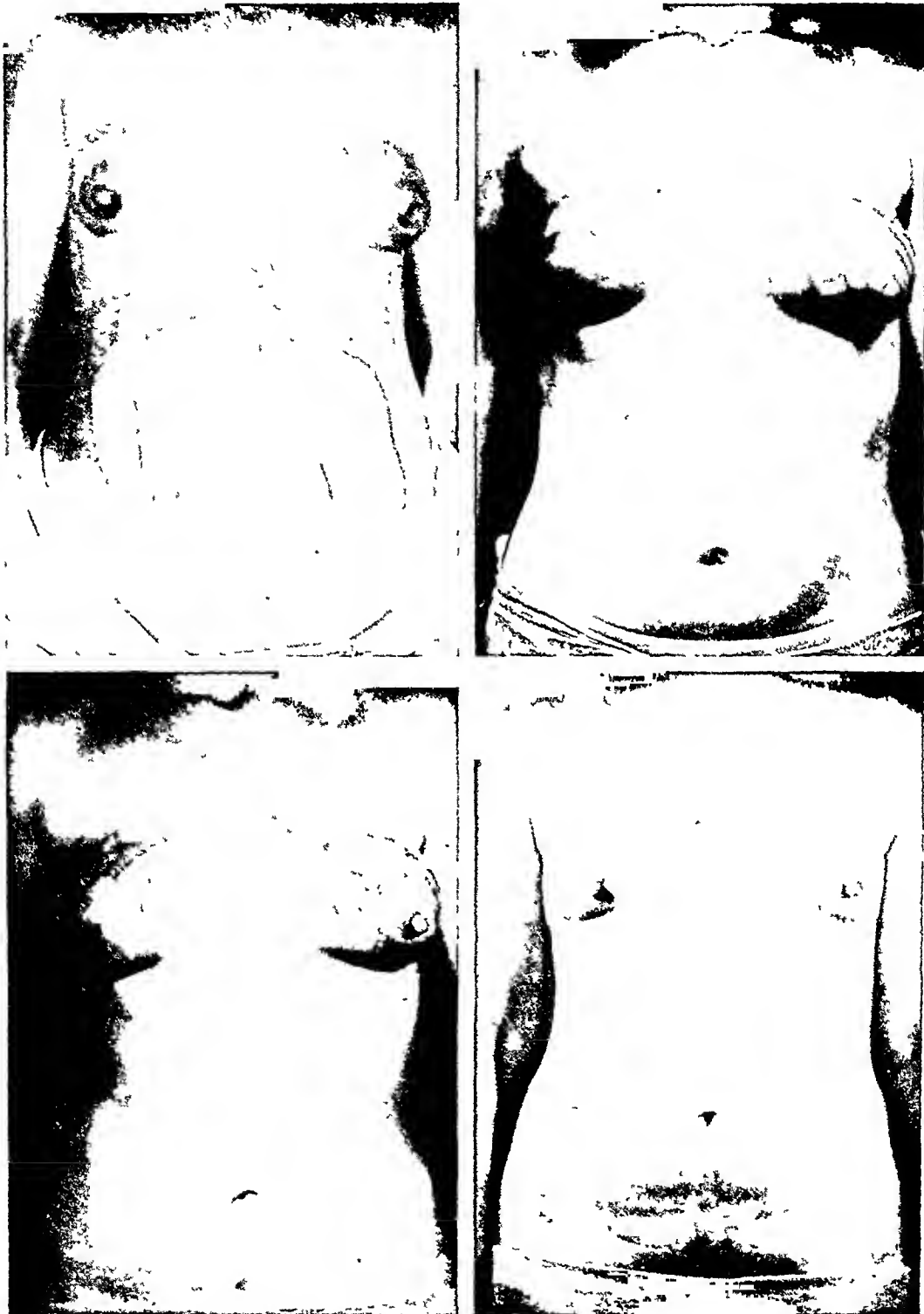


FIG. 1. The superficial veins during pregnancy and after delivery (during and after lactation). Upper left, thirty-nine weeks pregnant; upper right, three weeks postpartum, patient lactating; lower left, eight weeks postpartum, patient lactating; lower right, eight and one-half months after delivery, six weeks after the cessation of lactation. (Fig. 7, in Hamilton and Thomson's *The Heart in Pregnancy and the Childbearing Age*, Little, Brown & Company.)

ject would be "taken up and pursued by those who have greater facilities than I possess." The Boston Lying-In Hospital offered extraordinary facilities. Rheumatic heart disease is prevalent in Boston. The hook-up of cardiologist and obstetrician was an ideal one. As a result of the work done over these two decades by men of sound scientific attainments in this field we are offered the last word on this subject to date.

We agree with Dr. Hamilton in his Introduction: "The present low maternal mortality of cardiacs can be credited mainly to the rules for their selection and treatment, and nearly all of these many rules are the direct result of out-patient and bedside care, and the study of practitioners of large numbers of women of childbearing age who are cardiacs."

Book I deals with the cardiac in pregnancy. A chapter is devoted to importance, definition, classification, prognosis and treatment, and other chapters deal with treatment of cardiacs in pregnancy, delivery and obstetrical after-care of cardiacs and postpartum complications of cardiacs.

Book II covers physiology of the circulation in normal pregnancy and in pregnant women with cardiac disease.

Book III has eight chapters on heart diseases in pregnancy and the childbearing age. We especially urge one to read the chapters on the heart in preeclampsia, eclampsia and in hypertension and nephritis in pregnant women, rheumatic heart disease in pregnancy and the childbearing age, congenital defects of the heart and great vessels in pregnant women and women surviving puberty, thyroid heart in pregnancy and disorders of the heart beat in pregnancy and in women of childbearing age.

This, briefly, gives one an idea of the scope of this work.

Each author writes well although each has a different style. At no point does the book become dull. It "moves." For those who would delve deeper in the subject a Bibliography is appended at the end of each chapter and there is an ample Index.

Internists, especially those whose field is limited to cardiology, and obstetricians are sure to own a copy of this book, but we sincerely hope large numbers of general practitioners will buy copies and study carefully the printed pages, for they are the men, in the large majority, who do the obstetrics of this country, and on their shoulders will rest the decision of what cardiacs may become pregnant and what ones should be permitted to go to term. The end result is sure to be a lowered maternal mortality rate in those of the childbearing age who suffer from heart disease and become pregnant.

The American Journal of Surgery

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A PRACTICAL JOURNAL BUILT ON MERIT

NEW SERIES VOL. LIII

AUGUST, 1941

NUMBER TWO

Editorial

ANESTHESIA AS AN ART

"SCIENCE IS SYSTEMITIZED KNOWLEDGE—ART IS KNOWLEDGE
MADE EFFICIENT BY SKILL." J. G. GENUNG

THE recent resuscitation of the field of anesthesia through the various organizations by which it is being brought to the attention of the medical profession and the public, suggests an appraisal of the final objective to be achieved.

Is the major emphasis to be placed upon research or upon practice, upon the science or upon the art? Are both research and practice to be confined to a strictly professional personnel? Is the technician to be accepted or rejected?

The present practice of every hospital, large and small, of indulging indiscriminately in research, employing each new drug as it appears in medical and commercial literature, may be interesting and stimulating to the medical anesthetist who is obliged to spend many hours in routine supervision, but does the final result in reduced morbidity and mortality justify such emphasis? It would seem that research should be concentrated in the clinic possessing well equipped, specially trained personnel, having a large volume of well supervised clinical material and possessing facilities for careful postmortem checking.

Lack of mechanical skill or knowledge on the part of the anesthetic personnel is

frequently transferred to equipment designed to cover all shortcomings. It is easier to teach the management of equipment than it is to supply the pathological physiology which should serve as a guide to the anesthetist. The variations which regularly occur on the part of the physiological mechanism and its failure to fit into a predetermined pattern, are lost in the relatively large volume of satisfactory results. Science appears satisfied to turn out mechanics rather than physicians trained to use lethal drugs for the relief of the desperately ill patient. Emphasis is placed upon machinery rather than the unique physiology involved. The patient is expected to demonstrate the particular virtues of a drug or a technic by surviving exposure to it. Should not the drug and the technic be selected to contribute to the patient's margin of safety?

Let us consider briefly the distinction between the science and the art of anesthesia.

Science is concerned with systematized knowledge and is satisfied with knowledge as its goal. The science of anesthesia implies a knowledge of physiology and anatomy, of blood chemistry and of reflex arcs, of the pharmacology of drugs and the behavior of gases; knowledge of the latest equipment

and its particular advantages; knowledge of the history, the development and the practice of regional, epidural and sacral block and the best method of spinal anesthesia; knowledge of basal anesthetics and their indices, of antidotes and of analeptics; knowledge of pathological physiology and its specific bearing upon anesthetic drugs; knowledge of the circulation as a channel through which intravenous drugs may function; knowledge of fire hazards and of all the means suggested to reduce the incidence of explosion; knowledge of the mechanics of respiration and of the means of meeting violations of intra- and extrapulmonary pressure in operations upon the open chest; knowledge of the surgical procedure involving the respiratory airways, the specialities, obstetrics, the brain and the heart; and knowledge of anoxia, its historical background, its blood chemistry and modern methods of relief.

A man may be an expert in the science of anesthesia, and yet, given a patient, a can of ether and a towel, can he anesthetize such a patient for even a minor procedure, or given a tank of nitrous oxide or oxygen with a couple of yolks, rubber tubing and a mask, can he satisfactorily administer a gas oxygen anesthesia?

Of what value is the science of anesthesia to the patient, to the surgeon or to the anesthetist unless, in addition to accumulating information, the anesthetist has achieved success in developing discriminating judgment which will permit him to appraise his environment, the qualifications and limitations of the operating surgeon and the least dangerous of the hazards which the patient must face. Of what worth is this science unless the anesthetist can estimate resistance to surgery and to exposure by the feel of the tissues, the response of the reflexes; unless he can see pallor before the sphygmomanometer records it; unless he can react to anoxia before the surgeon informs him that the patient's blood is black; unless he can discard the latest type of gas machine for a tank of oxygen with a yolk and rubber

tubing as occasion offers; unless he be free of the hazard of faulty equipment and independent of precision adjustments designed to do his work for him and calculated to free him to record the story of the patient as it progresses. (Has a surgeon ever been known to interrupt his procedure to write about it, making the record more important than the surgery?)

An anesthetist is not a worthy practitioner of the art unless while knowing one anesthetic agent with the familiarity of long use he may leave it freely for another when the indication arises; unless he has learned one technic so well that he has taught it to meet the various problems which continually arise; unless he is familiar with the margin of failure to be encountered in local, regional and spinal methods and is willing to face the postoperative sequelae occurring in the last; unless he is willing to refuse to use basal anesthetics when these increase the hazard to the patient; unless he is willing to forego the ease of induction implied by premedication for better subsequent control of the patient; unless he insists that safety must come before comfort and has come to realize through his own and the experience of others that dependence cannot always be placed on antidotes; unless he has seen what may take place when gas is given to an infection of the neck and avertin or evipal for operations upon the jaw; unless he is prepared to meet the postoperative excitement of intravenous barbiturates and is familiar with the operative field which may be expected when moderate dosage is adhered to.

He does not place safety first unless he understands that the use of certain gases are intrinsically dangerous, that human nature, being what it is, all precautions will not be cared for; slips must occur; unless he is willing to substitute for such gases others known to be flammable but not at all likely to explode, even in the most exposed environment. Unless he is familiar with the facts that oxygenation of the chest case is *the* important factor; that the

mechanism of ventilation takes precedence over the anesthetic agent selected; unless he can recognize asphyxia when he sees it and is able to eliminate the death zone of the respiratory tract without calling upon the surgeon for help; unless he knows what the special fields of surgery under operation actually requires; i.e., the extent and the amount of relaxation, the control of reflexes, hemorrhage and the maintenance of asepsis; unless, in short, he is capable of putting into practice his scientific knowledge to the end that he may secure as smooth and as rapid an induction as conditions permit, a maintenance under complete control and a recovery free from immediate and remote effects.

The foregoing suggests that a true conception of the art of anesthesia implies a first class medical background. Anesthesia as an art is an evolution of the basic medical sciences from which the education of the physician anesthetist takes its source.

Technical workers may accumulate an assortment of revelant facts bearing upon the subject, but can no more create or judge than can the laboratory worker in other medical specialties.

"Art is knowledge made efficient by skill."

Routine anesthesia limited to a fixed field, under constant conditions as to agent, technic and operating personnel does not require basic scientific knowledge. A few, well considered rules yield a satisfactory background. In such team-work, the skilled artisan may be developed—a technician skilled in a limited field of the art.

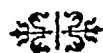
Such a technical artisan, supported and directed by a routine group will give a better anesthesia and will contribute to a better result, than the medical man familiar with the science of anesthesia but a stranger to the art.

It follows, therefore, that the physician who practices the art of anesthesia is familiar with its science. He is quick to seize upon any new agent or technic which promises him a more finished work. Conversely, he is slow to abandon old and familiar tools for others whose chief purpose is to make up for the lack of skill on the part of "the many."

The strictly supervised technician has a place in the hospital mass production problem, but only skilled artisans should be employed in this capacity. Deficiencies in skill may be made up in part by mechanized equipment. The glamor of the science of anesthesia, featuring novelty in drugs and gases and made impressive by costly equipment should not overshadow the reason for its existence "as an art" to make better surgery possible. The patient who is about to undergo an operation is the focal point about which all other factors must be made to turn. The anesthetic and the apparatus are merely tools for the accomplishment of a smooth and safe anesthesia. To make such tools complicated and impressive is to draw critical attention away from the patient. Simple tools have always been the mark of a true artist. Simplicity of mechanical approach, capable of producing a desired result, gives freedom and elasticity of control and by passing into the background of attention, allows interest to be directed exclusively to the vital phenomenon of life.

It is hoped that from the many who are familiar with the science of anesthesia there will, in the course of time, be evolved more and more physicians who may be referred to as worthy practitioners of the art.

PALUEL J. FLAGG, M.D.



Original Articles

THE LE FORT COLPOCLEISIS*

AN ANALYSIS OF THIRTY-ONE CASES WITH A DESCRIPTION OF THE TECHNIC
USED BY THE AUTHORS

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NEW ORLEANS, LOUISIANA

PROLAPSE of the uterus, or of the vagina following hysterectomy, in aged or elderly women though not endangering the patient's life, produces many annoying symptoms. A sensation of heaviness in the pelvis, and bladder symptoms, such as incontinence, dysuria and frequency, as well as local discomfort are frequently present. Many of the patients have associated medical conditions, namely hypertension, mild cardiac disease, diabetes or nephritis. These complications increase the surgical hazard for major operations such as vaginal hysterectomy or extensive plastic procedures. For this reason, the majority of these patients have been treated in a palliative manner by means of pessaries. However, the marked relaxation producing the cystocele or rectocele which usually accompanies complete prolapse, frequently prevents satisfactory utilization of a pessary to overcome the prolapse. In addition, the necessity of repeatedly having the pessary removed, cleansed and reinserted is objectionable. Any operative procedure that is devoid of all but a minimal amount of risk, that can be rapidly performed and that will produce lasting and satisfactory results is ideal for this condition. The Le Fort Colpocleisis,

which fills these requirements, is of proven value in this type of case.

This report is concerned with a critical analysis of thirty-one cases of genital prolapse, treated by means of the Le Fort procedure by nine members of the teaching staff of the Department of Gynecology of Tulane University in the public wards of Touro Infirmary and Charity Hospital of New Orleans, together with cases taken from the private practice of one of us. All members of the department do not use exactly the same technic. The majority follow the technic as set forth by Le Fort with the addition of a high perineal repair. The authors believe that more adequate support is obtained by also approximating the pubocervical fascia and levator fascia to each other. A description of the technic used by the authors is outlined later.

Of the thirty-one cases, eight patients, or 26 per cent had had a previous hysterectomy (seven abdominal, one vaginal), and complete prolapse of the vaginal vault was present. In another instance, a plastic operation and laparotomy had been performed in 1922; another had an application of radium in 1929. Thus a total of 32.5 per cent had previous gynecological operations. Of the entire group, twenty-five patients

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had complete prolapse (84.5 per cent), in five cases, though incomplete, the prolapse structures appeared at the vulva.

AGE

The youngest patient in the group was forty-eight years of age, the eldest seventy-eight. There were four women between the ages of forty-five and fifty-five (13 per cent), twelve patients between fifty-five and sixty-five (39 per cent), eleven patients between sixty-five and seventy-five (35 per cent) and five patient between seventy-five and eighty, (13 per cent). Forty-eight per cent of the patients were over sixty-five years of age.

COMPLICATING FACTORS

Twenty-five patients (80.5 per cent) had hypertension as a complicating factor. Of these, seven had systolic blood pressures ranging between 140 and 150 (19.5 per cent); in twelve, the systolic blood pressure ranged between 160 and 180 (39 per cent); in three, the systolic pressure ranged between 180 and 200 mm. Hg. (9.7 per cent). In two patients, the systolic blood pressure was over 200 mm. Hg. (6.5 per cent). Four patients had hypertensive cardiovascular disease, grade 2A (13 per cent), and one patient had severe diabetes with hypertensive cardiovascular disease (3.25 per cent).

SYMPTOMS

The most frequent complaints of the patients were pain in the lower abdomen, a sense of fullness and pressure in the vagina, local discomfort, dysuria, incontinence and frequency of urination. Thirty of the thirty-one patients (96.75 per cent) complained of lower abdominal pain, described a sensation of weight in the pelvis and local discomfort in the perineum. Sixteen (51.6 per cent) complained of dysuria, and twenty-two (71.5 per cent) complained of incontinence of urine on laughing, coughing, straining or sneezing. Two patients of the group had complete incontinence of urine. Frequency was noted in twenty-one cases (68.25 per cent).

HOSPITAL STAY

The total stay in the hospital of these patients was 522 days, an average of 16.7 days. The total postoperative stay in the hospital was 349 days or an average of 11.2 days for each patient. In many instances, a prolonged preoperative hospitalization was necessary in order to reduce the surgical risk. The shortest postoperative stay was five days, and the longest was thirty-three days.

ANESTHESIA

In sixteen cases local anesthesia was used (51.6 per cent), thirteen patients were given gas anesthesia (41.9 per cent), and two patients a spinal anesthesia (6.5 per cent). Local infiltration is the authors' choice of anesthesia for this procedure. It is interesting to note that the average operating time when local anesthesia was used was 33.4 minutes, whereas for those patients given gas anesthesia, 41.6 minutes were required to perform the operation. When spinal anesthesia was used, the operations lasted one hour to an hour and twenty minutes. Not only is the operating time approximately the same whether local anesthesia or gas is used, but there is a lessened danger of complications arising in the aged individual when the former agent is used for vaginal operations. Three patients required catheterization following the use of gas anesthesia and only one required catheterization after the use of local anesthesia. This series, of course, is not large enough to confirm our impression that patients given a local anesthesia require less catheterization than the patients operated upon under other forms of anesthesia. Local anesthesia comprises the use of local infiltration of tissue and pudendal block with a 1 per cent solution of novocaine. The patients experience very little or no discomfort throughout the operation.

COMPLICATIONS AND MORBIDITY

Of the entire group of thirty-one cases, only one had a morbid postoperative

course. This patient was given spinal anesthesia and a third degree laceration was repaired at the time of the Le Fort proce-

prior to operation, materially increases the blood supply of the vagina and produces a healthy, thicker mucous membrane, thus

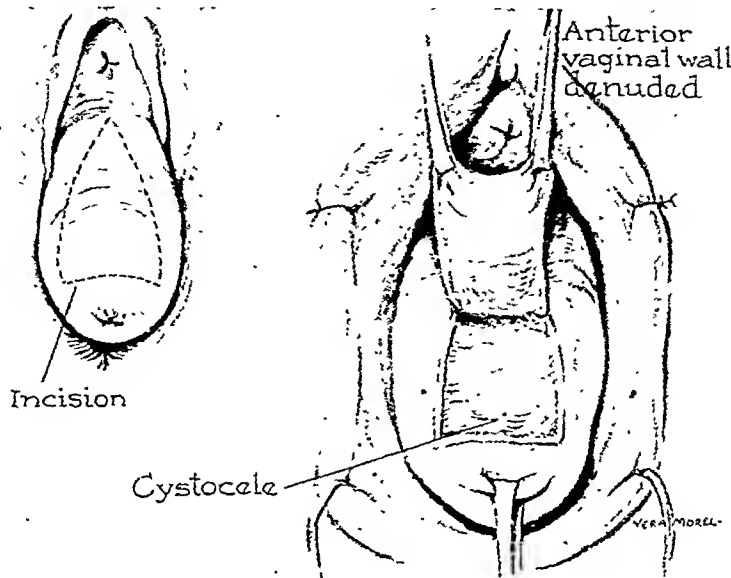


FIG. 1.

dure; the operation required one hour and forty-five minutes. This patient had an extremely stormy convalescence. Her temperature ranged to 105°F. and above, and she developed uremia postoperatively, but finally recovered. Of the remaining thirty patients, only three, or 9.75 per cent, had a temperature above 100°F. on any occasion, and none of these exceeded 101°F. The remaining 86.75 per cent, twenty-seven patients, did not have a temperature as high as 100°F. on any occasion following operation. In addition to the case described having uremia, one patient operated upon under local anesthesia developed a small rectovaginal fistula which healed spontaneously. In both patients an excellent postoperative result was obtained.

PREOPERATIVE PREPARATION

Needless to state, these patients should be placed in the best possible preoperative condition. Aside from general preoperative care the authors believe that the insertion of suppositories containing 2,000 International Units of the estrogenic hormone into the vagina for eight to fourteen days

lessening the danger of infection and facilitating the performance of the operation. A douche containing two tablespoonsful of vinegar to the quart of water should precede the insertion of each suppository.

OPERATIVE TECHNIC

The vagina and vulva are painted with tincture of merthiolate. The apex of the prolapse structures is grasped with the tenaculæ (Allis clamps if cervix has been previously removed), and an incision about 2 cm. in length is made horizontal to the apex and approximately 1 cm. from the apex on the anterior vaginal wall through the vaginal mucosa. A similar incision is made posteriorly.

The area to be denuded on the anterior vaginal wall is outlined by two incisions extending through the vaginal mucosa, beginning at the lateral margins of the initial incision on the anterior vaginal wall and continuing parallel to each other to within 2 cm. of the urethral orifice, where they converge to meet each other at a point 1 cm. below the urethral meatus. All vaginal mucous membrane thus outlined is

removed. The pubocervical fascia is identified and freed from the vaginal mucosa. (Fig. 1.)

the lateral and posterior vaginal walls. Another incision, following the mucocutaneous border of the vagina, joins these.

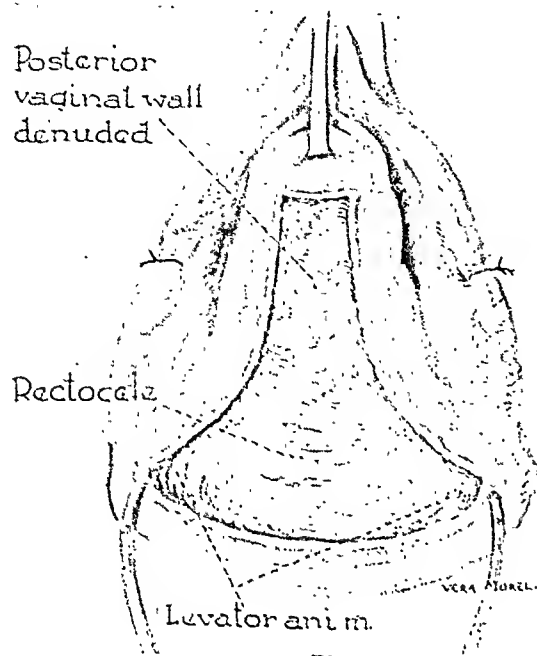


FIG. 2.

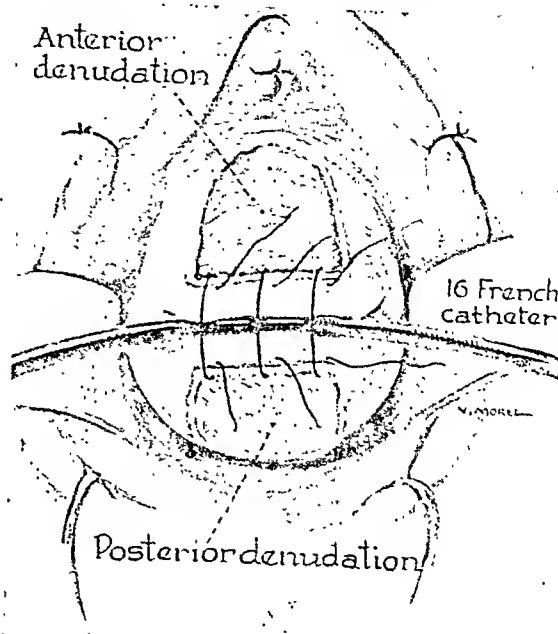


FIG. 3.

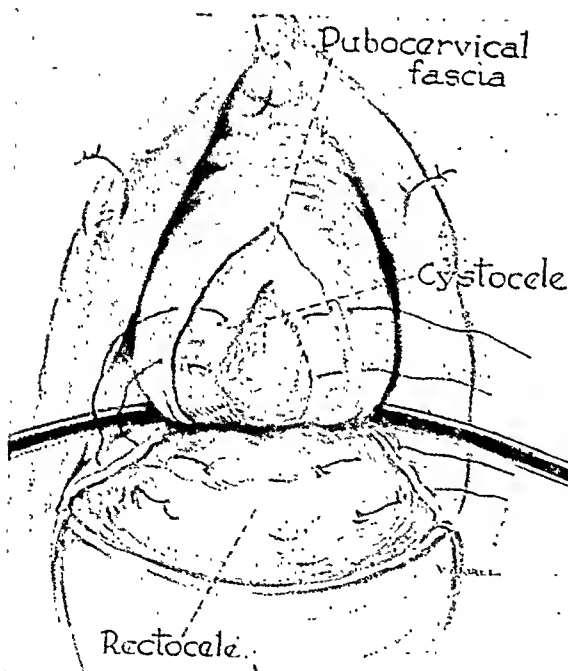


FIG. 4.

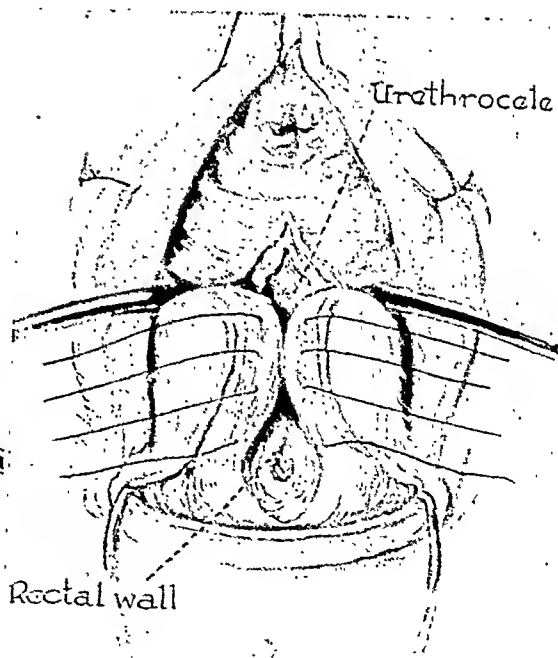


FIG. 5.

The area to be denuded posteriorly is outlined by two incisions (Fig. 2) carried through the vaginal mucous membrane and extending from the lateral margins of the incision made initially in the posterior vaginal mucosa. These incisions extend parallel to each other for a distance of 3 cm. and then diverge laterally to the junction of

The area thus outlined is denuded of vaginal mucous membrane.

A No. 16 French catheter is then placed against the apex of the prolapsed structures. (Fig. 3.) This catheter insures a canal of approximately the same diameter when the operation is completed and also serves for traction when necessary. Three

interrupted sutures join the anterior border and posterior border of the mucous membrane paralleling the apex of the structures. are then used to approximate the vaginal mucosa in the midline. (Fig. 6.) The catheter is then withdrawn.

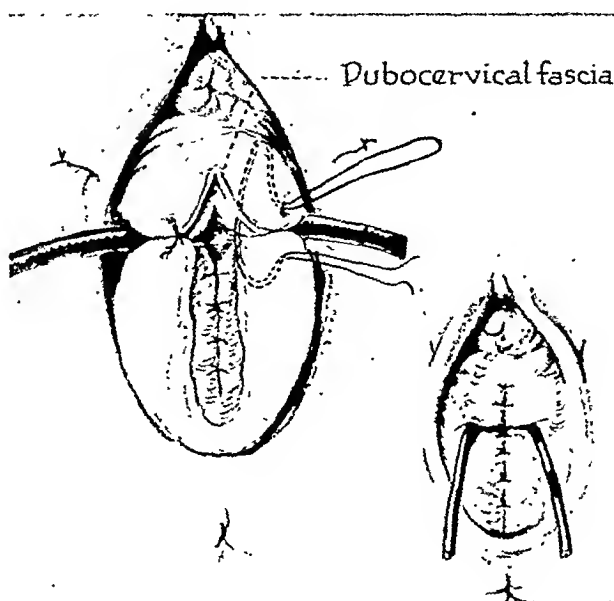


FIG. 6.

Two interrupted sutures are then placed. (Fig. 4.) These sutures pass successively through the mucous membrane of the anterior vaginal wall on the left side through the pubocervical fascia of the same side, the pubocervical fascia of the opposite side the mucous membrane of the opposite side, then through the mucous membrane of the posterior vaginal wall, the levator fascia of the right side, the levator fascia of the left side and the mucous membrane of the posterior vaginal wall on the left side. These sutures are then tied. In this manner, the pubocervical and levator fascia are approximated.

The levator ani muscles and fascia are then approximated by three or four interrupted sutures. (Fig. 5.) The levator muscle and fascia are then approximated to the ischio cavernosus (Fig. 6) muscle by a double suture passed successively through the mucous membrane of the posterior vaginal wall, the levator fascia and muscle, the ischio cavernosus muscle and the mucous membrane of the anterior vaginal wall. This is performed on both sides of the vagina. Three or four interrupted sutures

POSTOPERATIVE CARE

The patient is usually up in a rolling-chair on the third postoperative day. She is given a soft diet as soon as she desires food. Beginning on the third postoperative day, one ounce of mineral oil is given morning and night. No attempt is made to inhibit bowel function. As soon as the patient is allowed out of bed, she is placed in a hot Sitz bath twice daily, usually for a period of twenty minutes at a time for five to seven days. The duration of the bath is varied to suit the individual patient. The patient is allowed to walk on the fifth to seventh postoperative day. We believe that if elderly patients are allowed to be out of bed early, the chances of postoperative pulmonary complications are materially reduced. We have not noted any pulmonary complications in this series.

POSTOPERATIVE RESULTS

Perfect functional and anatomical results have been obtained in twenty-nine (93.5 per cent) of the thirty-one cases analyzed in this series. In one patient there was a

complete functional and anatomical failure. In another, an anatomical failure. In another, an anatomical failure of a marked degree, but fair symptomatic results. (The technic described by the authors was not used in these cases.) However, in one case, complete absorption of the suture material occurred in an exceptionally short time. We believe that factors that play a part in postoperative eversion were present here. In neither of these patients were estrogenic suppositories given preoperatively.

CONCLUSION

1. The Le Fort operation has a definite place in the management of elderly women with complete prolapse of the uterus or of the vagina following hysterectomy.

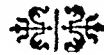
2. Its advantages are permanent anatomical restitution and symptomatic relief, with a minimal surgical risk.

3. The operation is easily and rapidly performed under local anesthesia.

4. The patient can be placed in a chair early and the dangers of postoperative pulmonary complications markedly reduced in this manner.

5. The danger of recurrence is lessened if one utilizes the pubocervical and levator fasciae, rather than relying solely upon approximation of the vaginal mucous membrane flaps and submucous tissues.

6. In this series of thirty-one cases, excellent results were obtained in 93.5 per cent of the patients. There were no deaths.



Warning: From a recent letter received from Dr. Elmer J. Ball, who published an article entitled "A New Treatment of Ganglion" in our December, 1940 issue, we quote as follows:

"There have been two severe reactions reported to me and I am afraid that this treatment carries too severe a risk to be used widely. In these cases an excessive amount of solution was used, but, nevertheless, where such a reaction does occur, the risk is too great for such an innocent tumor. The treatment does have merit, but further work should be done before it is widely used."

EXTRA-ARTICULAR ARTHRODESIS OF THE KNEE JOINT*

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OCCASIONALLY, in spite of the utmost care in selecting the time for operation, surgical invasion of a

The realization that fusion operations could not completely eradicate the tuberculous process, and that the most that could

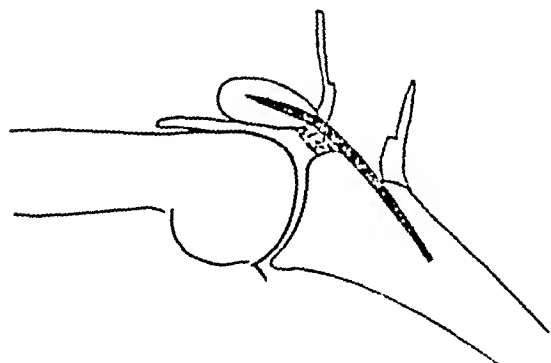


FIG. 1. Patellar ligament divided and turned upward; graft in place.

tuberculous knee is followed by direst consequences. Fistulae may follow the

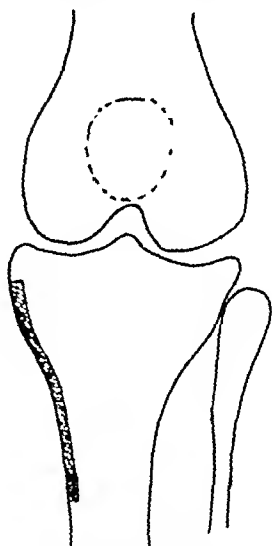


FIG. 2. Diagram to show source of graft.

operative procedure, secondary infection ensue, and amputation eventually become necessary.

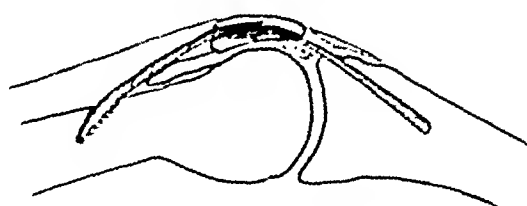


FIG. 3. Second state completed; both grafts in place.

be accomplished was its inactivation by preventing useless and dangerous motion, stimulated French orthopedists to develop an extra-articular method, as is done in the spine and hip.

In 1933, Delahaye¹ first recommended such a method for fusing tuberculous knees in children. He employed an extra-articular femoro-patello-tibial arthrodesis, using a long, supple graft taken from the opposite tibia.

Two years later (1935) Brandwayn,² a pupil of Delahaye, reviewed thirty-two cases (ages six to fourteen), in which the patients had been operated upon by this technic. None of these cases were more than two years postoperative. Pseudoarthroses and fractures of the grafts were frequent but were considered due to imperfection in technic. Two patients had developed secondary deformities, one a genu valgum and the other a genu recurvatum. The subsequent growth of the limbs had been symmetrical in all cases.

Calvet in 1937³ reviewed seventeen cases of knee joint tuberculosis in children treated by extra-articular fusion. Here again the cases were only one to one and a

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half years postoperative, but he also concluded that the graft grows at an equal rate with the limb. He reported two failures, one

children which had been fused in 1935 extra-articularly, and in which the results were unfavorable. In these cases the grafts

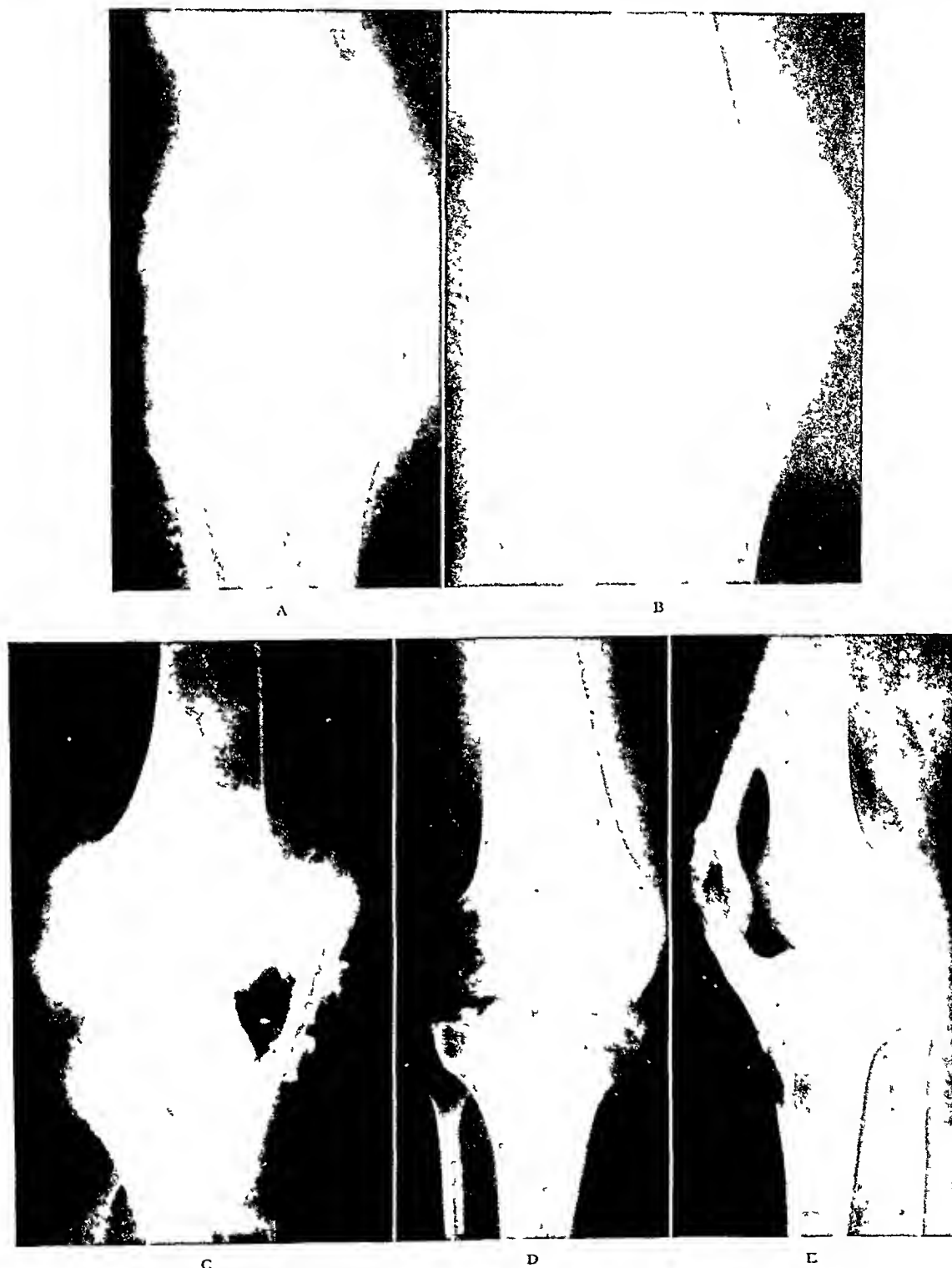


FIG. 4. Case 1. A and B, preoperative x-rays; C, immediately following first stage; D and E, four years postoperatively.

due to fracture of the graft, and the other to a pseudoarthrosis.

In 1939 Sorrel, Richard and Rouge⁴ reported nine cases of tuberculous knees in

children which had been fused in 1935 extra-articularly, and in which the results were unfavorable. They explained these undesirable results by stating that *the grafts do*

not grow at an equal rate with the limb. Both Lance and Delahaye, in discussing this article, stated that in their experience genu recurvatum had occurred frequently, after a period of two to three years.

articular arthrodesis did seem rational for the adult knee, and had sufficient appeal to lead us in 1936 to develop a suitable operative technic.

For children Delahaye³ recommended a



FIG. 5. Case 11. A and B, preoperative x-rays; C and D, four years postoperatively.

Extra-articular fusion for children has never appealed to us because the small size and cartilaginous character of the patella make it an unfavorable receptor for a graft. Furthermore, there is danger of growth arrest anteriorly from the graft crossing the epiphyseal lines.

On the other hand, the concept of extra-

long, supple, tibial graft, fastened to the femur above, passing downward through the patella into the tibia, in short, an extra-articular femoro-patello-tibial fusion. This technic cannot be used in adults because of the impossibility of securing such a long flexible graft. As possible sources of bone for the graft we considered rib and iliac

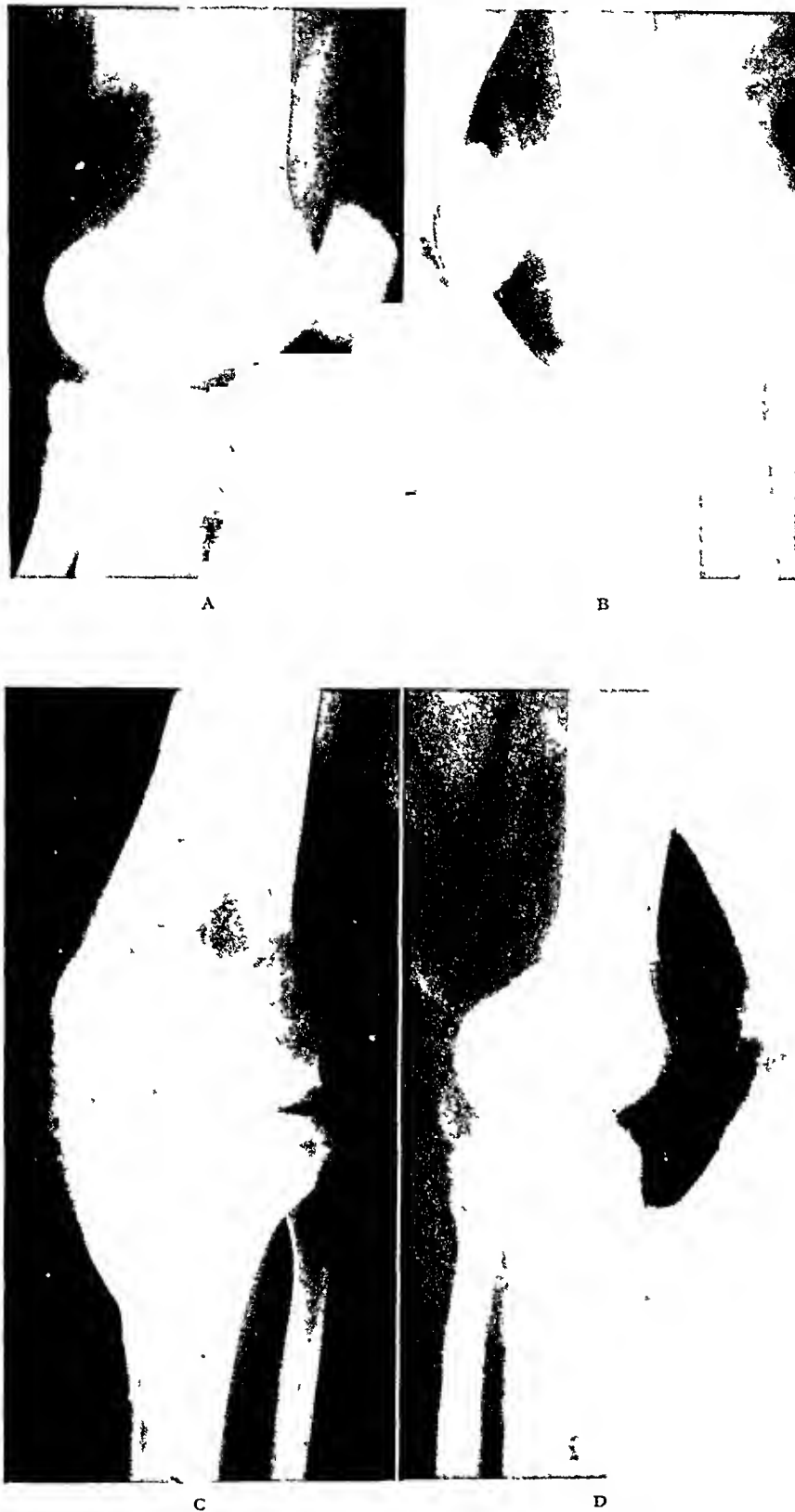


FIG. 6. Case III. A, preoperatively; B, two years postoperatively; C and D, four years postoperatively.

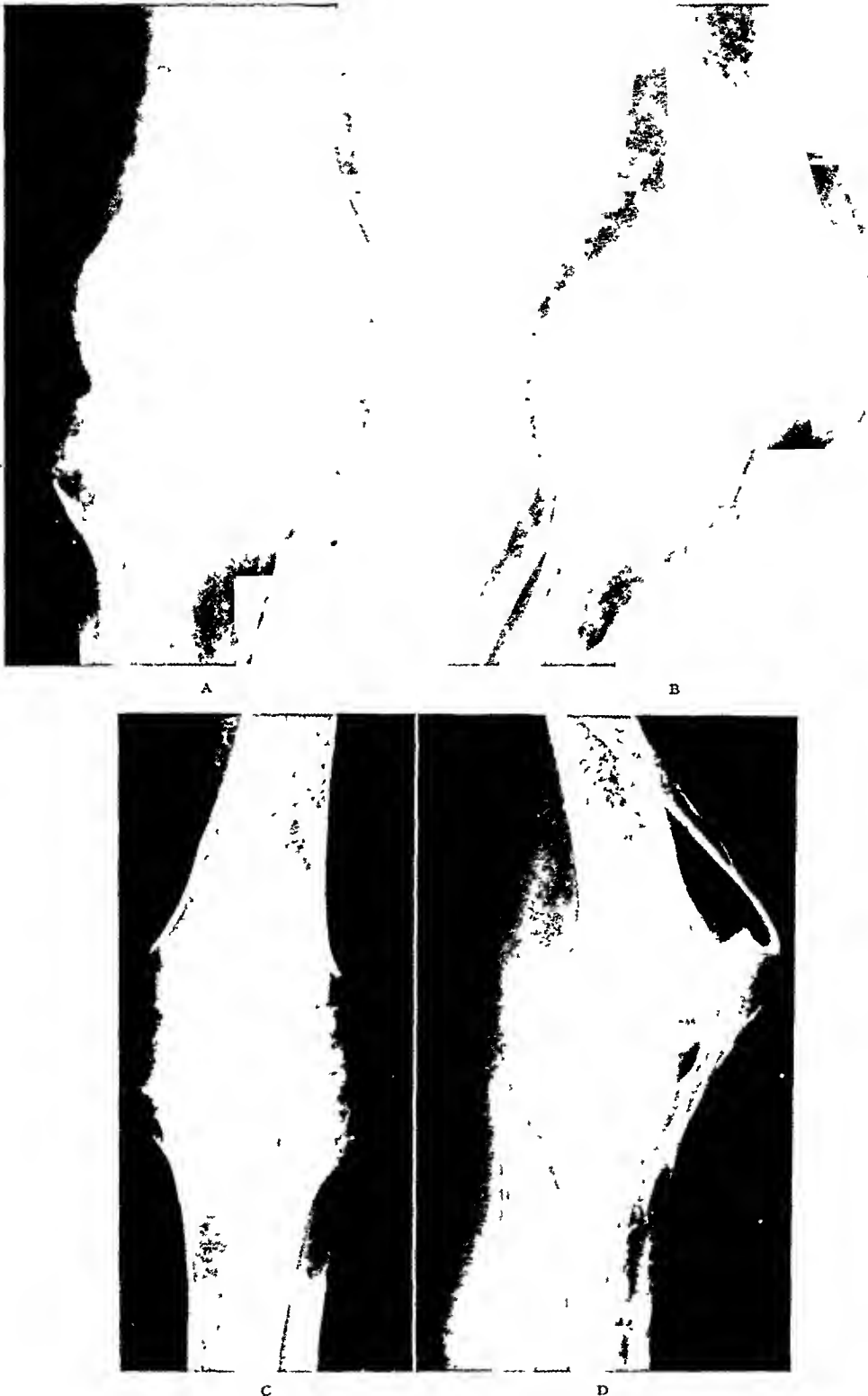


FIG. 7. Case IV. A and B, preoperatively; C and D, four years postoperatively.

crest. Rib seemed unsuitable because of its weakness. Iliac crest could not be used because of its two-directional curve.

We decided to do the operation in two stages using short tibial grafts.

This paper briefly describes the operative technic and the present status of four patients so treated four years ago.

TECHNIC OF OPERATION

First Stage. The incision begins at the superior border of the patella, passes downward over the medial surface of the tibial condyle and proximal shaft of the tibia. The patellar ligament is divided in a double "L" manner (Fig. 1) and retracted from the field of operation. The periosteum and tendinous attachments are elevated from the medial surface of the upper tibia and a cortical graft about five inches long is cut from the curved surface of the medial tibial condyle. The upper end of the graft is about one and one-half inches wide and its lower end is about one inch wide. (Fig. 2.)

A small amount of infrapatellar fatty mass is now excised and the beds for the graft ends are made by inserting an osteotome into the inferior two-thirds of the patella and in the cancellous bone of the tibia just under the bursa lying beneath the patellar ligament. The wide end of the graft is now placed in the patella and the narrow end in the tibia. The graft is reinforced by multiple chips of bone. The patellar ligament closes snugly over the graft, serving to hold it in place.

A long leg cast is applied and left in place six weeks.

Second Stage. A tibial graft is first removed from the opposite tibia. It is important to remove it high on the condyle so that it will be curved and pliable. The old incision over the patella is now opened and extended directly upward a distance of eight inches. The rectus femoris tendon is exposed and incised along with the muscle fibers overlying the synovial pouch where it extends upward under the quadriceps muscle. By careful dissection one can

expose the superior border of this pouch, and, in fact, by using a periosteal elevator, can displace it downward somewhat, so as to place the graft slightly farther distalward. A number of holes are now drilled through the cortex of the anterior surface of the femur just above the femoral condyle and the narrow end of the graft inserted. The wide flexible end is inserted into the superior border of the patella. The quadriceps muscle and tendon are closed firmly over the graft and a hip spica cast applied. (Fig. 3.)

After six weeks' time the spica is removed, an unpadded long leg cast is applied and the patient then becomes ambulatory. When the fusion is clinically and roentgenologically solid the patient is fitted with a long double upright brace.

CASE REPORTS

CASE I. An American housewife, age twenty-two years, with no pulmonary tuberculosis, had a painful, swollen left knee for five years. The test was positive for tuberculosis (Guinea pig). The first stage of the operation was performed on January 25, 1936; the second stage on February 20, 1936. The leg was kept in plaster for six months, followed by a brace for six months. She has been walking unsupported, doing her own work for one year.

October, 1939. The patient uses her leg normally; solid ankylosis has occurred in complete extension. She had had two draining sinuses, one in scar anteriorly just above patella, and the other in the popliteal fossa, but they have been healed for six months. There is no pain or inflammation.

CASE II. An Irish housewife, age twenty-eight years, had been under observation at Stanford Chest Clinic since 1932 for pleurisy and pulmonary tuberculosis. She had a painful, swollen right knee for six months. The test was positive for tuberculosis (biopsy). A long leg cast for four months had been applied before operation. The first stage of the operation was performed on January 22, 1936; the second stage on March 1, 1936.

June, 1938. Plaster fixation totaled nine months. She developed a sinus anteriorly which was still draining, but the patient walked unsupported without pain.

October, 1939. The patient used leg normally. Solid ankylosis occurred in complete extension. Two sinuses anteriorly never healed. She can hop and jump without pain.

CASE III. A colored girl, age seventeen years, with pulmonary tuberculosis, had pain and swelling in knee for nine months. The test was positive for tuberculosis (Guinea pig). The first stage of the operation was performed on March 23, 1936; the second stage on May 3, 1936.

June, 1938. Plaster fixation lasted nine months. She walked unsupported without pain and there were no sinuses.

October, 1939. The patient uses leg normally. Solid ankylosis took place in complete extension. There were no sinuses and no pain or inflammation.

CASE IV. A Mexican bootblack, age thirty-seven years, had pain, stiffness, and swelling of the left knee for five years. The test was positive for tuberculosis (Guinea pig). The first stage of the operation was performed on January 30, 1936; the second stage on February 27, 1936.

June, 1938. Plaster fixation lasted for six months. A long double upright brace was used for six months. He returned to work in six months. There were no sinuses and no pain.

October, 1939. The patient used leg normally. Solid ankylosis occurred in complete extension. He jumped and hopped on leg without pain and there were no sinuses.

CONCLUSIONS

We have reviewed the pertinent literature on extra-articular arthrodesis of tuberculous knee. Most of this work has been done by French surgeons on children, using long, supple tibial grafts. These grafts may fracture, shorten the limb or produce a secondary recurvatum deformity.

Four years ago we experimented with an extra-articular two-stage technic on four adults with tuberculous knees.

At this time the knees are solidly ankylosed. There have been no fractures or pseudoarthroses of the grafts, which in fact, have hypertrophied to an astonishing degree. In only one, Case IV is there an osseous fusion across the joint. The disease process is quiescent in all cases, although one patient still has a draining sinus.

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HYPOPROTHROMBINEMIA IN INTESTINAL DISORDERS*

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ACCORDING to the present concept of prothrombin formation, ingested vitamin K is absorbed from the intestinal tract in the presence of bile. On reaching the liver it in some way aids in the formation of prothrombin. A deficiency of prothrombin may result when the usual sequence of events is interrupted at any point. Hypoprothrombinemia, therefore, may result from any one or more of the following causes: (1) Absence of vitamin K. (Hemorrhagic disease of the newborn^{1,2} and starvation.) (2) Absence of bile from the intestinal tract. (Obstructive jaundice³ and complete biliary fistula.^{4,5}) (3) Loss of bile from the intestines. (External and internal intestinal fistula,⁶ repeated vomiting or intestinal intubation.) (4) Inadequate intestinal absorption. (Diarrhea and improper fat metabolism as seen in ulcerative colitis and nontropical sprue.⁶) (5) Decreased liver function. (Cirrhosis, leukemia, widespread carcinoma of the liver, hepatitis and anesthesia.⁷)

In June, 1939, Clark, Dixon, Butt and Snell reported seven cases of hypoprothrombinemia due to various intestinal disorders.⁶ During the past fifteen months we have seen seven somewhat similar cases.† Their series included one patient with nontropical sprue and one with bleeding ulcerative colitis. Quantitative prothrombin levels of 67 and 72 per cent, respectively, were found. In four similar cases which we have seen levels of 100 per cent of normal were present. We had one case of

severe chronic ulcerative colitis with frequent hemorrhages in which repeated determinations (Quick's⁸ method) were normal. However, we also believe that low levels could occur from faulty intestinal absorption but we think it would be rare in such cases for the blood prothrombin to fall to the bleeding zone (0 to 40 per cent of normal).

In practically all our patients whom we treated we have employed 2-methyl-1, 4-naphthoquinone and have used the iron salts of taurocholic and glycocholic acids when indicated.‡

Recently we saw three patients with peritonitis who had had practically no food for seven to twenty-eight days. The prothrombin level in these patients fell to 65, 70 and 75 per cent of normal, although each had received at least one transfusion of 500 cc. of citrated fresh blood. The blood prothrombin returned to normal in these patients when adequate food was given. In patients who are not receiving adequate diets and in whom intestinal intubation is being employed, we have noticed a more profound lowering of the blood prothrombin than in patients who have had only an inadequate diet.

Hypoprothrombinemia may occur in patients with a high ileostomy from a loss of either food products or bile, or a combination of the two. This opinion is also held by Clark, Dixon, Butt and Snell.⁶

Other workers have shown that inhalation anesthesia will produce temporary liver damage and even marked hepatic necrosis.⁷ Changes in the prothrombin level found in such conditions are in all probability related to the duration of the anes-

† Since August, 1940, when this article was sent for publication, we have had five additional similar cases. Three patients developed hypoprothrombinemia while the intestinal tube was being employed, one because of a high external intestinal fistula and one other who had a prolonged inadequate diet. All responded to vitamin K therapy.

‡ Supplied by Eli Lilly and Co., Indianapolis, Indiana.

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thetic and the amount of liver dysfunction produced by it, or to the effects of the anesthetic superimposed on an already diseased liver. We also believe that a fall of the prothrombin blood level of more than 5 to 10 per cent must be attributed to something other than the usual gas-oxygen-ether anesthesia.

In the cases which we are presenting we feel justified, therefore, in assuming that the postoperative decrease in prothrombin levels which were found resulted only in a small part, if any, from anesthesia, but were produced largely because of the lack of vitamin K, loss of bile or a combination of the two.

REPORT OF CASES

CASE I. This case is one in which the absence of vitamin K due to a prolonged inadequate diet probably caused hypoprothrombinemia.

A twenty year old, white man was admitted to University Hospitals of Cleveland because of pneumonia. Since the sputum showed type 1 pneumococci, sulfapyridine and type 1 anti-serum were given. He responded quite well to this treatment, but after six days the temperature, which had subsided, again became elevated. An empyema was found and a rib resection with drainage of the empyema cavity was performed. On the third postoperative day signs and symptoms of peritonitis developed. Not long after this intestinal obstruction developed, and an abscess localized in the left lower quadrant of his abdomen.

On the thirty-second hospital day an abdominal abscess was incised and drained. Type 1 pneumococci were demonstrated in the pus. A Miller-Abbott intestinal tube was passed. The patient had been on a decidedly inadequate diet for a month and a half. Two days later his wound, which previously had appeared to be healing, began to ooze blood which failed to clot. The blood prothrombin level was 21 per cent of normal. Four mg. of 2-methyl-1, 4-naphthoquinone were given that afternoon and the dose was repeated that evening. The following two days he received 6 mg. of the same drug. All bleeding had ceased in twenty-four hours and his prothrombin level was found to be 82 per cent after forty-eight hours of treatment. Five hundred cc. of citrated fresh blood were given and a soft diet was started. It was believed that no further vitamin K therapy

was necessary. Six days later the prothrombin blood level was 92 per cent. The patient continued to improve and was finally discharged from the hospital. At this time another prothrombin test was found to be 100 per cent of normal.

CASE II. In this case the absence of vitamin K in the diet and the loss of bile through the intestinal tube led to hypoprothrombinemia.

A thirty year old negress was admitted with intestinal obstruction and an abscess in the right lower quadrant of the abdomen which had been present for five days. It was believed that the infectious process was due to salpingitis with a resulting pelvic abscess. Intestinal intubation was begun. The patient's fever which was high fluctuated widely, but the obstructive symptoms gradually disappeared. On the fourteenth hospital day she passed a large amount of blood per rectum and also blood was sucked back through the intestinal tube which had passed as far as the terminal ileum. A prothrombin level was 6 per cent of normal. Two mg. of 2-methyl-1, 4-naphthoquinone and 0.64 Gm. of bile salts were given orally for three doses at three hour intervals. Fourteen hours later bleeding had ceased and the patient's prothrombin time was 100 per cent of normal. The hemoglobin had fallen from 70 to 30 per cent. The patient was given no more vitamin K but received 200 cc. of citrated blood. Twenty-four hours later the level was still 100 per cent. In the next seven days two transfusions of 600 cc. of citrated fresh blood and one of 500 cc. were given. The prothrombin level over the next week gradually fell from 94 to 84 per cent. At this time the intestinal tube was removed and a high caloric, soft diet was begun. No further bleeding occurred and the hemoglobin gradually rose to 69 per cent. A posterior colpotomy was done several weeks later and pus was encountered. The temperature subsided following this and she was discharged improved.

CASE III. Hypoprothrombinemia in this case was due to inadequate vitamin K intake and loss of bile due to prolonged gastric suction and a high external intestinal fistula.

A forty-two year old white man came to the hospital because of a perforated peptic ulcer. Plication of the ulcer under general anesthesia was done eighteen hours after the onset of the symptoms. Constant gastric suction was started postoperatively and the patient did fairly well until the wound disrupted on the seventh postoperative day. Secondary closure was carried

out. He received very little food except clear liquids for the next month and during most of the time was on gastric suction. Three weeks after admission an external intestinal fistula developed. About six weeks after admission a subdiaphragmatic abscess was drained, but the patient showed little improvement. Five days later blood was passed through the intestinal fistula and the edges of the wounds oozed blood. The prothrombin level was 20 per cent of normal. Attempts were made to give the patient vitamin K orally but it was repeatedly vomited. The patient ran a septic course and died two days later. Autopsy revealed multiple abscesses of the lungs, liver and kidneys, and a large amount of old and fresh blood throughout the entire intestinal tract.

CASE IV. Hypoprothrombinemia in this case apparently resulted from both inadequate vitamin K intake and loss of bile due to a high intestinal fistula.

A fifty-nine year old white woman was admitted to the hospital with a preoperative diagnosis of annular carcinoma of the stomach. After preoperative preparation and two blood transfusions a subtotal gastrectomy was performed. Grossly the stomach appeared to be the seat of carcinoma. Although numerous microscopic sections were studied, no evidence of tumor could be found and the final pathological diagnosis was acute and chronic inflammation. A tube was put into the small intestines through the gastrojejunostomy at the time of operation with expectation of starting early feedings. The patient did poorly postoperatively and the wound disrupted. Shortly after this a high external intestinal fistula developed. On the eleventh and twelfth days after operation spontaneous bleeding from the wound occurred with slight evidence of clotting. The prothrombin content of the blood was 21 per cent of normal. Six mg. of 2-methyl-1, 4-naphthoquinone were inserted rectally but expelled; therefore, 4 mg. in intravenous saline were given. Fourteen hours later a catheter was inserted through the disrupted wound into a loop of jejunum and no bleeding was encountered. The prothrombin time was then 75 per cent of normal. Two mg. of 2-methyl-1, 4-naphthoquinone were given through the jejunostomy tube and this was repeated five hours later. One hour after the last dose the prothrombin level was 95 per cent of normal. During the next three days the patient received 2 mg. more of vitamin K and 500 cc. of blood. The prothrombin level at the end of this time was 100 per cent of

normal. However, bronchopneumonia developed and diffuse fibropurulent peritonitis. The patient died two days later. Autopsy revealed no evidence of bleeding.

CASE V. In the following case loss of bile because of intestinal intubation and external intestinal fistula, combined with occasional attacks of diarrhea and inadequate vitamin K intake, led to hypoprothrombinemia.

A thirty-two year old white female who was pregnant for nine months was admitted to the hospital because of appendicitis. Postoperatively, the patient was given sedatives in an attempt to prevent early termination of the pregnancy but without success. A term child was delivered on her second postoperative day. On the third postpartum day and fifth postoperative day, since signs of marked ileus were present, constant gastric suction was begun. The McBurney incision disrupted on the ninth postoperative day. After this an external intestinal fistula developed and occasional attacks of fairly severe diarrhea occurred. Intermittent gastric suction was employed. Six hundred cc. of citrated blood were given on the tenth, seventeenth and thirty-third postoperative days. The patient had shown no gross bleeding, but because of the possibility of hypoprothrombinemia a prothrombin test was performed. It was 33 per cent of normal. On her thirty-fourth postoperative day the level had risen to 40 per cent. Four mg. of 2-methyl-1, 4-naphthoquinone were given with 0.32 Gm. of bile salts. Twenty hours later the prothrombin blood level was 82 per cent of normal. One mg. of 2-methyl-1, 4-naphthoquinone was given every other day, and after four days the prothrombin level was found to be 76 per cent of normal. It was believed that the failure to respond after the last dose was probably due to the loss of bile by intermittent intestinal suction and through the intestinal fistula. The same dose of vitamin K with 0.32 Gm. of bile salts was given, and the intestinal suction was discontinued. The prothrombin level rapidly rose to 100 per cent of normal. She subsequently died from peritonitis.

CASE VI. In this patient, prolonged vomiting led to a slight prothrombin deficiency.

A thirty-three year old white woman was admitted because of vomiting. She had apparently been quite well until eighteen years of age when these vomiting spells began. During the few years preceding admission the patient had experienced marked epigastric distress and fullness and had lost considerable weight. Her

stomach was greatly dilated, and there was marked retention. Roentgenograms showed marked pyloric stenosis. Because of the prolonged illness and inadequate absorption, a prothrombin blood level was determined and found to be 80 per cent of normal. It was believed that subtotal gastrectomy was advisable and because of the possibility of a prolonged postoperative course this patient was given 4 mg. of 2-methyl-1, 4-naphthoquinone and 0.64 Gm. of bile salts. The blood prothrombin rose to 94 per cent in twenty-four hours. One mg. of 2-methyl-1, 4-naphthoquinone and 0.32 Gm. of bile salts were given the following day, and twenty-four hours later a prothrombin blood level of 100 per cent was present. The patient subsequently had a gastrectomy performed and died on the third postoperative day from a beta streptococcus peritonitis. The prothrombin time fell only slightly postoperatively.

CASE VII. In this patient a vitamin K deficiency resulted because of an inadequate diet.

A seventy-five year old woman was admitted to the hospital with a strangulated ventral hernia. Resection of two feet of the ileum was necessary because of a gangrenous loop of bowel. Postoperatively, she did very well, although she was on a very meager diet, until her seventeenth day when she passed the first of three bloody stools. A prothrombin time was 20 per cent of normal; therefore, 2 mg. of synthetic vitamin K were given four times in the next twenty-four hours. At the end of this time all bleeding had ceased and the prothrombin time had risen to 88 per cent of normal. Two mg. of 2-methyl-1, 4-naphthoquinone and 0.32 Gm. of bile salts were given twice in the next twenty-four hours and following this the prothrombin time was 100 per cent of normal. It remained there until her discharge from the hospital five days later, and no further bleeding occurred.

COMMENT

The cases presented show that in prolonged intestinal obstruction or dysfunction, hypoprothrombinemia does develop. Such cases, as well as those of obstructive jaundice, biliary fistulae or hemorrhagic disease of the newborn, have prothrombin levels of 100 per cent of normal or close to it after twelve to forty-eight hours of treat-

ment (4 to 12 mg. of 2-methyl-1, 4-naphthoquinone, and bile salts given when indicated) provided that good liver function is present.

Recently we treated three patients with obstructive jaundice (two of whom were bleeding) who had prothrombin levels of 5 per cent, 10 per cent and 31 per cent of normal, respectively. Eight mg. of 2-methyl-1, 4-naphthoquinone and bile salts were given, and prothrombin blood levels of 100 per cent of normal were obtained in forty-eight hours or less.

We ran all tests by the method described by Quick,⁸ and results were carefully checked and compared with normal blood daily. Recently the modification described by Stewart and Pohle,^{9,10} has been employed, but we have found that these results change the percentage values very little, if at all.

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THE TREATMENT OF STAPHYLOCOCCIC INFECTIONS WITH THIAZOLE DERIVATIVES OF SULFANILAMIDE

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THIS paper consists of a report of the observations and conclusions made during the treatment of 130 cases of staphylococcic infections of various types during the past year with thiazole derivatives of sulfanilamide. Both 2 (para-amino-benzene-sulfonamido) thiazole and its methylated derivative, 2 (para-amino-benzene-sulfonamido) 4-methyl thiazole, or sulfathiazole and sulfamethylthiazole,* were used.

While three-fourths of the cases were seen in two hospitals, the entire series is made up of patients treated in fourteen hospitals, many in conjunction with their own attending physicians. As some of these may be reported individually in detail by their own physicians at some later date, no attempt has been made to present them here in such a manner. The cases of furuncles of the face, carbuncles and abscesses reported previously by Beling and Abel¹ are included in this series.

The investigation was originally undertaken to determine the effect of the thiazoles on acute staphylococcic infections that are usually fatal, with the hope that some significant reduction of mortality could be obtained. The results of the writer and other investigators with staphylococcic antitoxin and with specific bacteriophage during the past five years have left much to be desired. A plan of clinical research was evolved and put into effect in various hospitals in Essex County, New Jersey. During the first five months the drugs were given only to patients with staphylococcic bacter-

emia, acute osteomyelitis, acute staphylococcic cellulitis, furuncles and carbuncles of the face, carbuncles with generalized systemic reaction, acute infections in diabetics, and acute infections of the urinary tract. Later, the use of the drugs was extended to less severe infections caused by the staphylococcus, including ambulatory patients. A special treatment data sheet was attached to the chart of each patient for the recording of the following information: The amount of each dose, the time and route of administration with corresponding temperature, pulse and respiration; daily determination of the level of free drug in the blood in milligrams per cent; results of daily blood counts, urinalyses, blood and wound cultures; additional therapy, and remarks regarding reactions, improvement of condition and any other information pertaining to the progress of the case. An instruction sheet was supplied to each ward, private pavilion, intern and resident with full directions for administration of the drugs in various forms, the minimum requirements for laboratory work, warnings regarding other medications and the possibility of the development of reactions with instructions for their detection. Thus a close check was kept upon the use of the drugs and all reactions carefully watched.

The results in the first thirty patients treated with sulfamethylthiazole indicated that it was a relatively safe drug to administer, and its use was extended to less severe staphylococcic infections. This drug was withdrawn from use, however, because of the several cases of lower motor neurone involvement or so-called peripheral neuritis that had been observed by a few investiga-

*The sulfathiazole and sulfamethylthiazole were supplied by the Department of Medical Research of the Winthrop Chemical Company and the Maltbie Chemical Company.

tors. Sulfathiazole was substituted and was used in all subsequent cases. Since no lower motor neurone effect had been reported in patients receiving this drug, it was considered justifiable to employ it for ambulatory patients. Fifty-two patients received sulfamethylthiazole and seventy-eight took sulfathiazole.

All determinations of the free and total drug in the blood, urine and feces were done according to the method of Bratton and Marshall,² utilizing N (1-naphthyl) ethylene diamine dihydrochloride as the coupling dye. Many of the determinations were done with the use of alcohol as the extracting agent. More recently trichloroacetic acid has been used for extraction.⁶ It seems to produce a more definite color and lends itself to more accurate determinations. The standards for the latter tend to fade more rapidly, however.

TYPES OF CASES

Staphylococci were identified either from the wounds or the blood stream in all cases. Seventeen cases exhibited mixed infection

TABLE I
TYPES OF ORGANISMS

Organism	Cases	Sulfathiazole	Sulfamethylthiazole
Staphylococcus:			
Aureus	73	41	32
Albus	34	22	12
Unclassified	23	11	12
Streptococcus	17	8	9
Bacillus pyocyaneus	1	1	0

with both streptococci and staphylococci, and in one instance *Bacillus pyocyaneus* was present. Tables I and II illustrate the types of organisms encountered and the various conditions treated.

ADMINISTRATION AND DOSAGE

Oral. Both sulfathiazole and sulfamethylthiazole were used in this series. The earlier patients received sulfamethylthia-

zole in powdered form, made up into $\frac{1}{2}$ Gm. capsules which were later supplanted by $\frac{1}{2}$ Gm. tablets. Sulfathiazole was used in tablet form only. The tablets were given by mouth and swallowed whole with a little water or were powdered and suspended in milk. The first few adults of 150 pounds or more were given an initial dose of 3 Gm. followed by 2 Gm. every four hours

TABLE II
CONDITIONS TREATED

Condition	No. Cases	Sulfathiazole	Sulfamethylthiazole
Septicemia	11	6	5
Bacteremia	3	2	1
Abscess	22	12	10
Furuncle—face	12	8	4
Body	8	7	1
Carbuncles—face	5	1	4
Neck and body	14	12	2
Cellulitis	19	11	8
Infected wound	23	9	14
Cystitis and pyelitis	10	7	3
Pneumonia (staph.)	11	7	4
Empyema (staph.)	5	3	2
Thyroiditis	1	0	1
Breast abscess	1	0	1
Chronic osteomyelitis	7	2	5
Acute osteomyelitis—long bones	5	4	1
Fingers and toes	5	3	2
Pyoderma	3	0	3
Peritonitis	1	0	1
Diabetes	6	2	4

day and night. Extremely severe cases, such as patients with septicemia, were given as much as 5 Gm. initially, children taking 1 Gm. per twenty-five pounds. These doses were found to be unnecessary in the average case and it became routine to give an initial dose of 2 Gm. and maintenance doses of 1 Gm. every four hours to adults. Children received an initial dose of 0.5 Gm. per twenty-five pounds of body weight and maintenance doses of 0.25 Gm. per twenty-five pounds every four hours, calculated to the nearest $\frac{1}{2}$ Gm. It was often necessary to exceed this dose with children in order to reach and maintain a reasonable level of free drug in the blood.

In fact, all maintenance doses should be recalculated after the first blood level of free drug has been taken, eighteen to twenty-four hours after commencing treatment, and should be adjusted to maintain the level desired. Occasionally adults may require large doses. When it was not advisable to give the drug by mouth, it was introduced through a tube into the upper duodenum.

Intravenous. Whenever it was desirable or necessary to obtain an immediate elevated blood level of free drug the sodium salts, sodium sulfathiazole and sodium sulfamethylthiazole, were utilized. The sodium sulfamethylthiazole was prepared in the laboratory by treating sulfamethylthiazole with sodium hydroxide in equal molecular proportions, as follows: 0.8 Gm. of sodium hydroxide dissolved in 54 cc. of distilled water were titrated into a flask containing 5.38 Gm. of sulfamethylthiazole. After solution had taken place, the contents of the flask were filtered and the pH adjusted to 10.4 or just above, never over 10.5. The solution was then sterilized by boiling and placed in sterile rubber capped vials for parenteral use. A slightly yellow color usually developed and numerous crystals came down onto the bottom of the vials. The resulting solution was about 10 per cent. Sodium sulfathiazole was obtained in white powdered form directly from the manufacturers, thus eliminating a repetition of the above process. It was supplied in ampoules containing 1 Gm. After opening an ampoule, the powder was mixed with 20 cc. of sterile distilled water and thoroughly agitated in a 20 cc. syringe to facilitate solution. Injection into the patient was then performed. From 2 to 3 Gm. of sodium salt were used for the average adult of 150 pounds or 75 Kg. and corresponding amounts for children. In either case, a limit of 75 mg. per Kg. of body weight or 300 mg. per ten pounds was not exceeded. Such intravenous injections must be given slowly, preferably over five to fifteen minutes. One-half the initial dose can then be given every four hours, if

necessary. Whenever possible it is best to supplement intravenous injection by oral medication. Rapid and repeated intravenous administration of strongly alkaline solutions may cause troublesome thrombosis and even laking of red blood cells. The sodium salts were not used in this study unless it was impossible to give the drug in the regular way. Few patients, therefore, received intravenous injections. It is my conclusion that the frequent use of these compounds intravenously is not justified because of their potential danger to the local blood vessels and to the kidneys. Large numbers of crystals are invariably seen in the urine after injection of the sodium salts into the blood stream.

Rectal. Both sulfamethylthiazole and sulfathiazole were given by rectum in a few cases because of the inability of some patients to tolerate them by mouth. The drugs were powdered and suspended in water or saline solution before instillation into the rectum. The technic is simple and similar to rectal use of sulfapyridine and sulfanilamide. It was not satisfactory from the standpoint of absorption.

Local. After receiving assurance that the process of manufacture of the thiazoles was such that the presence of spores of organisms in the finished product was extremely unlikely, it was decided to try the drugs locally in wounds. During January, 1940, sulfamethylthiazole was utilized in this manner, employing a saturated solution of the powder in sterile normal physiological saline solution or in distilled water. For practical purposes, the aqueous solubility of sulfamethylthiazole was considered to be 200 mg. per liter at 28°C. If the water was warmed to body temperature or higher, about 230 mg. went into solution. This 20 mg. per cent solution was used for open, infected wounds and was prepared in the hospital by adding the appropriate amount of powdered drug to a flask of warm, sterile, physiological saline solution and warming to body temperature. Sulfathiazole was employed in the same manner, except that its relatively increased

solubility resulted in a 60 mg. per cent solution with the addition of the proper amount of powder. On cooling, crystals came down out of each of these solutions. No attempt was made to filter out the crystals and they were allowed to go into the wound. The application of this method of treatment will depend upon each individual wound. Although one will do better with irrigation at frequent intervals with a syringe, others may respond more readily to a continuous drip delivered into the depths of the wound through perforated tubes in the manner of Dakinization. The latter seems to be advisable in extensive compound fractures with macerated tissue and loss of substance. The usual sterile precautions must not be omitted. I have also introduced the powdered drug directly into surgical wounds and into the peritoneal cavity, but the results do not lie within the scope of this paper. Powder or crystals are probably superior when one wishes to débride and close a wound tight without drainage.

ABSORPTION AND EXCRETION

The absorption of the thiazoles from the human gastrointestinal tract varies widely in certain individuals, although it is fairly constant on the whole. It may even vary in the same individual from day to day. We must assume that, since absorption takes place from the intestinal tract, there are a number of factors such as the rapidity of the passage of material through the tract and the condition of the mucous membranes of the various portions with regard to their power of absorption at any given time. It is impossible, therefore, to draw any comparative conclusions regarding the amount and rate of absorption of the drugs in humans, except to show some parallelism in the behavior of large groups of individuals.

The thiazoles are excreted much more rapidly than sulfanilamide or sulfapyridine, and this has an important bearing on the time interval between doses. The drugs should be given every four hours in order to maintain an adequate blood level. This was

sometimes difficult in children because of extremely rapid excretion. Absorption from the gastrointestinal tract was less even than with sulfanilamide and more even than with sulfapyridine. On the average it was satisfactory. Variations in absorption were demonstrated in the same individual by daily fluctuations of from 1 to 2 mg. per cent on regularly maintained and spaced dosage. In the earlier patients who received sulfamethylthiazole it was noted that the average adult exhibited a blood level around 7.0 mg. per cent of free drug after receiving from 20 to 25 Gm. by mouth during the first forty-eight hours prior to the determination. Analysis of later cases revealed that an initial dose of 2 Gm. followed by 1 Gm. every four hours usually resulted in a blood level of free drug in adults of about 4.0 mg. per cent and almost always in a level about 2.9 mg. per cent. Absorption apparently continued with larger doses and blood levels of free drug exceeding 20 mg. per cent were obtained. The maintenance of a steady blood level in children could not be predicted by rule and was achieved by trial in each individual case, always keeping in mind that excretion is extremely rapid and that in some children doses of 2 Gm. every four hours may be necessary to reach and maintain a level of 4.0 to 6.0 mg. per cent.

The thiazoles were not absorbed readily from the rectum, even under the most advantageous conditions. Although no attempt was made to determine the optimum percentage concentration for absorption, it is reasonable to assume that such must exist. The established behavior of glucose solutions in the rectum gives us the basis for this assumption. At best, one cannot hope for adequate blood levels from rectal administration of the thiazoles.

As far as has been determined, the use of saturated solutions locally in open wounds does not result in a sufficiently high level of drug in the blood stream to be detected by tests routinely employed.

After the thiazoles enter the blood stream they exist there in the free form and

would be excreted as such if not for the fact that acetylation or conjugation takes place, probably in the liver. Sometimes the longer the drug remains in the blood stream the more of it becomes conjugated. This has been demonstrated with single doses administered to patients with impaired renal function. They acetylated as much as from 50 to 70 per cent of the drug. The average adult in this study acetylated approximately 29 per cent, calculated from all the determinations of free and total drug made. Children, owing to very rapid excretion, sometimes acetylated very little of the drug. Under normal conditions, therefore, the amount of sulfathiazole or sulfamethylthiazole conjugated is low in comparison to the free form. The proportion of acetylated drug is relatively high in the urine and very low in the stools. The experience of other investigators in this direction is closely parallel.

The blood stream is entirely cleared of the thiazoles, as far as can be detected by routine tests, in twenty-four to forty-eight hours depending upon the amount of drug in the circulation at the time medication is discontinued, other things being normal. Excretion takes place mainly through the kidneys and slightly through the gastrointestinal tract, so that both forms are recovered from the urine and feces. Crystals of both may appear in the urine.

TOLERATION AND REACTIONS

Because of the relationship of sulfathiazole and sulfamethylthiazole to sulfanilamide and its various other derivatives, it was logical to assume that the thiazoles might produce reactions similar to those already observed when the other compounds were administered. All patients were carefully watched, therefore, for the development of such reactions as nausea and vomiting, anemia, leukopenia, agranulocytosis, hyperpyrexia, skin rashes, hematuria, urinary disturbances including anuria and lithiasis, cyanosis, psychic disturbances, neuritis and other phenomena. The various toxic manifestations that occurred

in this series are listed in Table III. Sulfathiazole caused less side effects of serious nature and was better tolerated than sulfamethylthiazole. One patient receiving sulfamethylthiazole developed a mild lower

TABLE III
TOXIC MANIFESTATIONS

Reactions	Sulfa-thiazole		Sulfa-methyl-thiazole		Both Drugs	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Nausea.....	21	26.95	17	32.70	38	29.20
Vomiting.....	8	10.25	11	21.18	17	13.19
Headache.....	8	10.25	7	13.46	15	11.54
Dizziness.....	6	7.68	1	1.93	7	5.38
Weakness of extremities.....	3	3.84	1	1.93	4	3.68
Muscular pains....	0	0.00	0	0.00	0	0.00
Neuritis.....	0	0.00	1	1.93	1	0.77
Hyperpyrexia.....	2	2.56	1	1.93	1	0.77
Skin rash.....	4	5.12	4	7.69	8	6.16
Diarrhea.....	1	1.28	0	0.00	1	0.77
Hematuria.....	2	2.56	3	5.48	5	3.84
Pyuria.....	0	0.00	1	1.93	1	0.77
Crystalluria.....	10	12.82	20	38.50	30	23.08
Renal calculi.....	0	0.00	0	0.00	0	0.00
Anemia.....	0	0.00	2	3.85	2	1.54
Leukopenia.....	0	0.00	0	0.00	0	0.00
Cyanosis.....	0	0.00	5	9.62	5	3.84
Psychic disturbance.	0	0.00	0	0.00	0	0.00
Diplopia.....	0	0.00	2	3.85	2	1.54
Conjunctivitis.....	2	2.56	0	0.00	2	1.54

motor neurone involvement. Two patients taking sulfamethylthiazole experienced diplopia on the tenth and twelfth days, respectively. In both instances it disappeared within forty-eight hours after discontinuing the drug, reappeared when medication was resumed and promptly disappeared the second time after permanent withdrawal. There were no residual signs or symptoms. Neither patient took a large amount of the drug at any one dose but took it over a period of from four to six weeks, with blood levels around 4.0 mg. per cent of free drug. Five patients exhibited cyanosis from sulfamethylthiazole and in each case the intensity of the cyanosis was more or less dependent upon the blood

level. After the level was adjusted to lower figures, around 4 to 5 mg. per cent, the cyanosis became scarcely noticeable. It was

spread of infection in the presence of an adequate blood level of sulfathiazole is most unlikely, not having occurred once in

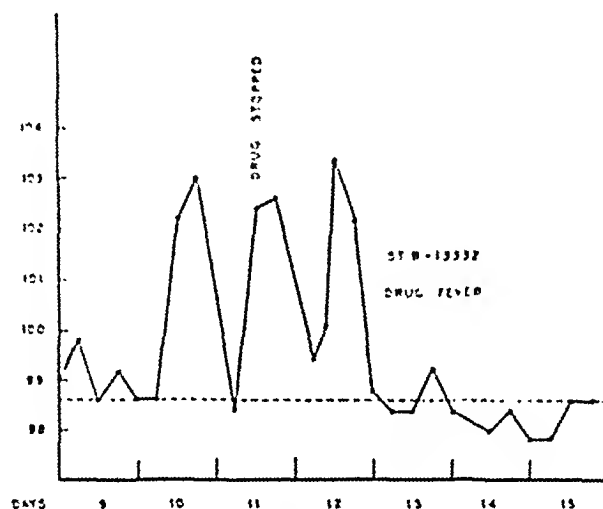


FIG. 1.

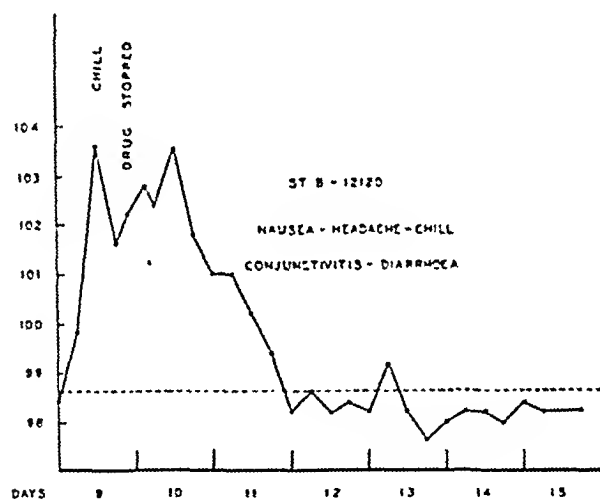


FIG. 2.

quite evident when the blood level was around 7 to 9 mg. per cent. None of these side effects occurred with sulfathiazole.

The presence of several types of reactions in the same case is not uncommon. Some of the reactions may present a problem in management, such as the determination of the cause of a fever. Is the fever due to a drug reaction or to the disease itself? Since the majority of drug fevers occur around the sixth to ninth days, since there are few lesions due to the staphylococcus which are not fairly well under control with reduction of temperature by that time, and since the

this series, we must assume that any unusual temperature reaction between the fifth and tenth day is probably due to the drug. If our assumption is correct, and it will usually be so, the fever will promptly be reduced with the disappearance of the drug from the blood stream during the ensuing twenty-four to forty-eight hours. (Fig. 1.) Hyperpyrexia from the thiazoles may manifest itself as a steady elevation of temperature, as a more or less gradual or abrupt rise, or as a septic type of fever with wide spikes (Fig. 2) and occasionally with chills. (Fig. 1.) Skin rashes are said to be

rather common but were noted in but seven cases of the combined series and only three times with sulfathiazole. They took the form of either papular erythematous or scarlatiniform eruptions except that one patient had lesions similar to erythema nodosum. In no instance did the rash progress in severity when the drug was continued. In this connection it is important to note that the thiazoles differ from sulfanilamide in their reaction to various rays. Photosensitization apparently did not occur and it was possible to combine roentgen and sulfathiazole therapy without any of the sensitizing effect reported with sulfanilamide.⁵ Furthermore, sulfathiazole may be given to persons who are up and about in the sunlight without any evidence of photosensitization. Likewise, ultraviolet light is not contraindicated during the course of treatment.

Injection of the sclerae and conjunctivae similar to acute conjunctivitis or common "pink-eye" was experienced by three of the patients taking sulfathiazole and it occurred on the seventh, ninth and twenty-fourth days. One patient had a combination of conjunctival and scleral injection, an erythema nodosum type of rash, headache and general malaise. These were severe but disappeared within forty-eight hours after discontinuing medication. She received about 3 Gm. daily for several weeks before the reactions set in. Two months later, after having resumed medication for several days and having taken about 20 Gm., the same reactions reappeared. This time the drug was not stopped. After four days the conjunctival and scleral reactions cleared entirely. The erythematous nodules continued but also disappeared after one week. The drug was continued at the rate of 3 Gm. daily and no further reactions developed until two weeks later when she again experienced slight scleral and conjunctival reaction for three days associated with a tired feeling. The urine was normal at all times and no further reactions developed. Hematuria was noticed in four patients, three of whom received sulfamethylthia-

zole. In all but two instances the hematuria was microscopic. The urine of one patient had a slightly red tinge when the drug was discontinued. The hematuria appeared in these cases at any time between the second to the forty-second day. Crystals of free and conjugated drug were commonly seen in the urine. Sulfamethylthiazole crystals were especially abundant and were frequently mistaken for urates. Sulfathiazole crystals were often reported as leucine and tyrosine. Occasionally there was a temporary diminution of urinary output. One patient had a severe staphylococcic septicemia and exhibited gross hematuria with great reduction of urinary output bordering on anuria. Sulfathiazole was discontinued immediately and the output and urine became normal in three days. The problem then was whether to allow him to die from the septicemia or to continue giving the drug and take a chance on the kidneys failing. The latter was decided upon and, surprisingly enough, he had no further reactions and recovered nicely from the septicemia.

Nausea is a frequent feature of thiazole therapy, being experienced by 26.95 per cent of the patients who took sulfathiazole and 32.70 per cent of those who took sulfamethylthiazole. Vomiting was several times more frequent with the latter. Headache sometimes accompanied the nausea but was more liable to be present if there was vomiting. There were two ambulatory patients who merit special attention. Both took sulfathiazole by mouth in the usual quantities. While their infections were acute they experienced no reactions other than a slight loss of appetite. After twelve days and 52 Gm., and eleven days and 49 Gm., respectively, they presented almost identical symptoms including severe headache, nausea, dizziness, sweating, extreme weakness most noticeable in the lower extremities, and occasional vomiting. The second man also had a shaking chill lasting about fifteen minutes. In both cases the symptoms disappeared entirely within forty-eight hours after discontinuing the

drug. When medication was resumed one week later in the first case, the symptoms returned after ingestion of 4 Gm. and were severe. They again disappeared completely within forty-eight hours after stopping the drug. There were no residual signs or symptoms one week later.

Particular mention must be made of the absence of acute anemia, leukopenia or agranulocytosis in the sulfathiazole series. A gradual reduction of red cells was observed in one case of staphylococcal pneumonia. The erythrocyte count was 3,380,000 and the hemoglobin was 72 per cent when thiazole therapy was commenced and at the end of the fourteenth day the hemoglobin was 60 per cent and the erythrocytes numbered 3,080,000. A transfusion of 500 cc. of whole blood was given. A young white male with a large carbuncle of the buttock, showed a decrease of his leukocyte count from 19,000 to 5,000 in four days, but it came up to 6,600 while the drug was being given. One gradual anemia was encountered with sulfamethylthiazole. Another patient received sodium sulfamethylthiazole by vein and suffered a rapid laking of blood probably due to the extreme alkalinity of the solution and somewhat to the speed of the injection. Her erythrocyte count was reduced by 1,000,000 cells and her hemoglobin by 21 per cent within thirty-six hours. Transfusion restored it and there was apparently no depressant effect of the drug on the hematopoietic system.

The appearance of reactions to the thiazoles does not seem to have any direct relationship to the amount of drug given, and sometimes the most severe reactions were seen with smaller aggregate amounts. The patients in this series received total doses of from 4 Gm. of sulfamethylthiazole and 8 Gm. of sulfathiazole to 244 Gm. of sulfamethylthiazole and 295.5 Gm. of sulfathiazole over periods varying from two days to sixty-six days with sulfathiazole and to seventy-five days with sulfamethylthiazole. The majority of those patients who took the drugs for longer periods did

not have troublesome reactions. The management of patients after reactions have appeared is extremely important and therein often lies success or failure. Should we discontinue thiazole medication when reactions develop? The answer is best given from the combined experience of the various investigators and not from some unsubstantiated idea which may happen to exist in any individual's mind. My own observations are that withdrawal of the drug is not indicated in the presence of nausea, occasional vomiting, headache, crystalluria, skin rashes and conjunctival reactions except under unusual circumstances. These side effects tend to pass off within twenty-four to seventy-two hours. Occasionally vomiting may be persistent or a skin eruption may be especially severe so that medication must be stopped. Whenever there is an adequate urinary output, over 1,000 cc. daily, the appearance of large numbers of crystals in the urine should not require modification of dosage. When the output is low, efforts should be made to improve this rather than to withdraw the drug. Moderate anemia has not been considered an indication for withdrawal and in at least one case therapy was continued with small transfusions as adjuncts. Microscopic hematuria was also noted but the drug was not taken away unless the urine was slightly tinged with red or there seemed to be increasingly larger numbers of red cells per high power field on microscopic examination. Absolute indications for cessation of thiazole therapy, unless modified by further clinical evaluation, are the appearance of gross hematuria, hyperpyrexia, conjunctivitis of severe nature, neuritic symptoms and signs, chills, severe psychic disturbance, and also agranulocytosis, leukopenia and acute anemia if they should occur. The last three were not encountered in this series. Whenever such reactions do occur, the drug should be withdrawn immediately and fluids administered in large quantities to promote excretion. It is also advisable to administer a rapid acting cathartic to eliminate any unab-

sorbed and whatever excreted drug exists in the gastrointestinal tract. All these reactions will, as far as my observations indicate, respond to this simple régime.

EVALUATION OF TREATMENT

Of the entire series of 130 staphylococcic infections treated with the thiazoles, 116 were improved, five were not improved and nine patients died. The criterion for improvement was that the lesion being treated must resolve and disappear within a reasonable time, the length of which depends upon the type of lesion. As four patients died from infection by other organisms after the staphylococcic infection had been successfully eliminated, this number should rightly be added to the list of improved, making a total of 120, or 92.3 per cent. The remaining deaths were due strictly to staphylococcic disease or staphylococcic septicemia. All but one were not seen until very late in the course of the disease and from three to twelve hours before death. The presence of extensive metastatic lesions precluded the hope of recovery. They must be included, however, in order to make any valid comparison with the gross uncorrected mortality in staphylococcic septicemia both untreated and treated by other means. One patient with a local cellulitis died after several days treatment. He had pneumonia, nephritis and a long history of chronic and recent acute alcoholism prior to admission. His cellulitis was not the cause of death. One of the patients not improved was a sixty-two year old black female, diabetic with honeycombed abscesses throughout the scalp and subaponeurotic region, preceded by cellulitis following an injury to the scalp. Staphylococci were repeatedly cultured from the pus. Roentgen therapy also failed to have any appreciable effect. The other four patients who failed to respond to the thiazoles either had chronic osteomyelitis with sequestra or had various conditions other than staphylococcic infection which accounted for the main clinical picture.

Recurrences were unusual except in the

presence of mechanical factors in urinary tract infections, such as renal calculi. This statement applies only to those patients who have been adequately treated from the standpoint of dosage and time. It is easy to obtain recurrences if the dosage is too low or the drug has been withdrawn too soon. This is particularly liable to happen in staphylococcic pneumonia and staphylococcic septicemia. The earlier cases in the series were tapered off toward the end by reducing the dosage gradually to complete withdrawal over several days to a week. Because it was concluded that the very low blood levels of the drugs during the last days of treatment were not sufficient for any appreciable effect, this method was abandoned and it is now my practice to continue treatment up to the time of withdrawal so as to maintain a more or less constant blood level of free drug, and then to stop the dosage abruptly. The free drug in the blood stream diminishes rapidly according to the individual rate of excretion. Pyodermias, carbuncles, infected wounds, cellulitis and abscesses were treated until the lesion had resolved or disappeared. Febrile conditions such as staphylococcic peritonitis, endometritis or pneumonia were treated until the temperature, pulse and respirations had been normal for at least one week. Later in the series this time was reduced to four days. It is absolutely essential that all acute osteomyelitis and other forms of staphylococcic septicemia be treated for longer periods in order to prevent recurrences which are almost inevitable with small doses and inadequate treatment time. In my opinion these cases should receive full doses, with a maintained free drug blood level of from 6 to 9 mg. per cent, until all blood cultures are negative, until collections of pus that can be reached have been drained surgically and have healed, and until the temperature, pulse and respirations have been normal for at least two weeks. Treatment should be resumed at the slightest indication of a relapse. This means that patients with acute osteomyelitis, for example, may re-

ceive the drug for many weeks. Urinary infections which are not complicated by mechanical factors such as calculi and certain abnormalities of the genitourinary tract may be handled much in the same manner as carbuncles and febrile conditions. When these other factors are present, however, the problem is a difficult one and the percentage of recurrences must be high. The first course of the drug should be continued for several weeks after subsidence of all symptoms and therapy should be immediately reinstituted when any symptoms return. One of the patients so treated had the complicating factor of a kidney stone. After the first three series of treatments with sulfathiazole he remained symptom free without any abnormal urinary findings for about one month each time. With each successive period of treatment the free interval became shorter so that his hematuria, pyuria, burning and frequency returned within one week. Considerably smaller doses of the thiazoles are sufficient to control staphylococcal urinary infections. Even though the blood level of free drug is 2 mg. per cent or lower, the concentration in the urine is high. For example, if a patient receives as little as 1 Gm. daily and half of this amount is excreted into the urine and the urinary output is 2,000 cc. daily, there will be 0.5 Gm. in 2,000 cc. or a 25 mg. per cent solution. This concentration has been shown to have the effect of reducing the growth of *Staphylococcus aureus* in the urine.⁴ When other organisms are present, and for complete elimination of the staphylococcus, concentrations of 50 mg. per cent or higher are necessary. The results with chronic osteomyelitis would be very disappointing if the mechanical factors were not taken into consideration. The poor response of certain cases can probably be attributed to this factor. As long as sequestra are present discharge will continue to flow from the sinuses. The use of sulfathiazole before and following operative removal of such sequestra is, of course, logical and indicated.

Neither the thiazoles nor any other drug can perform the duties of the scalpel. This

point cannot be too frequently or strongly emphasized. Collections of pus must be evacuated and the indications for surgical drainage are certainly not altered by the fact that a drug is being given. The use of sulfathiazole preoperatively in adequate amounts, however, is advised for its effect in preventing the spread of infection locally and the development of generalized hematogenous infection. If prompt operation is necessary, the intravenous administration of sodium sulfathiazole will create a proper blood level quickly. As long as there is an abscess under tension, thiazole medication will not cause a drop of the temperature until evacuation has been accomplished. Rapid subsidence follows. Small abscesses may sometimes absorb. This advice does not apply to furuncles or carbuncles. These will evacuate spontaneously and readily when the thiazoles are supplemented with warm wet dressings. Occasionally, a carbuncle may require a minimum amount of surgery well within the limits of the infected area. The behavior of furuncles, carbuncles and abscesses under thiazole therapy has been set forth more fully in a previous communication.¹

The length of time required for any given staphylococcal lesion to respond depends upon its type and the stage of its development. Too often I have heard the careless statement that if sulfathiazole does not do its work in three days, it will not be of any use. Such statements are misleading, ill advised and inaccurate. In fact, one hears many curious statements regarding the sulfonamide derivatives which have little to substantiate them but which seem to stick in the minds of both the practitioner and the public. Furuncles and carbuncles will show definite changes within three days, often progressing to complete resolution. Certain cases of cellulitis, on the other hand, require up to eight days and occasionally longer. No reasonable person should expect miraculous cures of staphylococcal pneumonia, acute osteomyelitis and staphylococcal septicemia within two or three days.

The most dramatic and satisfying results in this series were seen in cases with staphylococcic septicemia and with infections of the dangerous area of the face. The reduction of mortality to 27 per cent in the former group is tremendously significant when compared with the results from staphylococcus antitoxin and specific bacteriophage. This will be reported at length at a later date. There were twenty-six cases of facial infections. They all recovered although some of the patients had particularly grave and extensive infections. One girl had cellulitis of the nose, face and eyelids, an abscess of the nose, thrombophlebitis of the angular and ophthalmic veins and orbital cellulitis. An elderly white male, diabetic, had a similar process, with a carbuncle of the eyelids, nose and forehead. A young male had another similar process about the face and eye with involvement of the angular vein and proven bacteremia. They all recovered rapidly. The mortality in such untreated advanced cases and the incidence of cavernous sinus involvement is not small, particularly after trauma, which was a factor in each of the cases cited. The behavior of acute staphylococcic osteomyelitis is very interesting. To date five patients have been treated from the inception of the disease. All have recovered. Each had a soft tissue abscess incised and drained and the bone or periosteum were not disturbed. Each abscess healed up completely. There are now no draining sinuses and there has been replacement of bone in each patient. Although the longest follow-up period is six months after discharge from the hospital and the patient has shown no recurrence or residual disability, sufficient time has not elapsed to allow any conclusions as to the eventual results. Immobilization of the affected part was employed in each case in addition to thiazole therapy.

It has been suggested that roentgen therapy is contraindicated when thiazoles are being given. This has probably been prompted by the reports of photosensitization following exposure of patients

receiving sulfanilamide to roentgen rays, ultraviolet lamps and strong sunlight.⁵ There is no basis in fact for this assumption. No evidence of photosensitization was noted in the cases that were exposed to the effects of both types of agents. Furthermore, other reports to the contrary,³ the combination of thiazoles and roentgen rays did not appear to influence the course or outcome appreciably so that it cannot be said from this experience that there is any antagonism or synergism between the two agents. There would not seem to be any virtue, therefore, to the addition of roentgen therapy to the management of these cases. This is not to be construed as criticism of the roentgen ray, which may produce satisfying results by itself.

Both sulfamethylthiazole and sulfathiazole were used locally in solution or in powdered form. In one instance the powder was made up with petrolatum to make an ointment. The results of the use of powder are not embodied in this report. Treatment was confined to extensive open infected wounds. One patient had a compound fracture of the leg involving both bones with associated maceration and considerable loss of substance. He received the solution through Dakin tubes inserted into the depths of the wound. Aerobic streptococci and staphylococci were effectively inhibited but anaerobic streptococci were frequently cultured from the discharge. These were taken care of by the use of zinc peroxide paste at the same time. An elderly diabetic female had an extensive mixed infection of her foot and leg with progressive sloughing. Staphylococci and anaerobic streptococci were cultured from the discharge. Sulfamethylthiazole solution locally caused the staphylococci to disappear and they never again became a feature of the infection which was later progressive and ended in death. She was unable to tolerate the drug by mouth. Other patients received the drug by mouth at the same time. The introduction of saturated solutions of the thiazoles in water or normal saline permits the exposure of certain tissues to concentrations far

in excess of those obtained for the same tissues when the drug is given orally only. The combination of the two routes should be advantageous in properly selected cases. The combination of zinc peroxide cream with saturated sulfathiazole solution deserves special attention and will probably take care of mixed infections involving the staphylococcus and anaerobic streptococci or other organisms.

DISCUSSION

At the present time, sulfathiazole is the only chemotherapeutic agent available and officially accepted that is strongly active against the staphylococcus. This study indicates that sulfamethylthiazole is at least as active. It has not been officially accepted because of some serious reactions such as neuritis. A significant reduction of the mortality in the severe staphylococcal infections including septicemia, pneumonia, and infections of the dangerous area of the face indicates the value of the thiazoles as compared with sulfanilamide and sulfapyridine.

While the reactions from sulfathiazole do not seem to be dangerous clinically and although the nausea and vomiting are of milder character and more transient, one must not be deceived into a false sense of security. Investigation with animals has demonstrated the fact that the thiazoles can produce serious kidney damage and have also shown the mechanism by which the damage is produced. Apparently free drug can be precipitated as well as the conjugated drug. The findings in animals should not, however, prejudice our clinical conclusions and I am convinced that these severe reactions are not usual when humans are being treated so that their blood level of free drug is below 10 mg. per cent. Furthermore, if some precipitation does take place in the kidney when the urinary output is normal or better, the condition is probably not irreversible. It is also my opinion that the mortality of untreated staphylococcus septicemia is so great that the risk of serious reactions is relatively inconsequential.

The use of sulfamethylthiazole would be entirely justified if not for the evidence that sulfathiazole is about as efficient. Certainly the thiazoles are not drugs that can be used carelessly. Every patient receiving sulfathiazole should be carefully watched by his physician and a certain minimum of laboratory-work performed.

Although the thiazoles are active against the staphylococcus, they cause reactions and are potentially dangerous unless properly handled. There is, therefore, a need for some new drug which will be comparatively nontoxic and still more active. Until such a drug is discovered, they offer real help in the treatment of severe staphylococcal infections.

SUMMARY

One hundred thirty cases of staphylococcal infections treated with thiazole derivatives of sulfanilamide are reported. Fifty-two patients received sulfamethylthiazole and seventy-eight took sulfathiazole. The types of organisms and the conditions treated are listed. Oral, intravenous, rectal and local administration of the drugs are discussed, including indications, dosage and efficacy.

The thiazoles are rapidly excreted through the kidneys in free and combined form. Approximately 29 per cent of the sulfathiazole was acetylated by the cases in this study. The blood stream is cleared in twenty-four to forty-eight hours.

The various toxic manifestations encountered are listed and the reactions discussed. No anemia, leukopenia, renal calculi, cyanosis or neuritis resulted from sulfathiazole. Sulfamethylthiazole caused one case of lower motor neurone involvement, two cases of anemia and five cases of cyanosis. Two cases of diplopia are recorded for the first time. The management of toxic reactions is discussed.

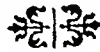
Ninety-two and three-tenth per cent of the cases were improved; five of those who did not improve failed to show any response to treatment and the others died. The

mortality of staphylococcic septicemia in this study was 27 per cent.

Although sulfamethylthiazole has strong action against staphylococcus, it is a potentially dangerous drug. Sulfathiazole is the only efficient, accepted drug for the treatment of staphylococcic infections.

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To the physician and health official, it is of the utmost importance to know how poliomyelitis is spread. In general, there are only a few ways by which infection can be transmitted; by direct contact, or by indirect contact through objects or fomites, by insects or through the gastro-intestinal tract. If it is the gastro-intestinal tract, food, water, milk, or contact may all play a part.

TREATMENT OF FRACTURES OF THE PATELLA BY PARTIAL EXCISION OF FRAGMENTS*

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FRACTURES of the patella have always been a subject of interest and even in the earliest books on surgery much was written on the different methods of treatment. In the work of Ambrose Paré, fracture of the patella or whirllbone was recognized as a serious injury. Paré after reduction advised that the patient "must lie or keep in bed for at least forty days." He stated his prognosis as follows: "I have seen none of those who have had this bone fractured who have not halted the rest of their lives." Over sixty years ago Lister performed an open reduction on a fractured patella using wires to approximate the fragments. The operative result was satisfactory and this method of treatment was considered a great triumph for the antiseptic theory advocated by him.

It is unnecessary at this time and not the purpose of this paper to enumerate the various methods of treatment that have been advocated and used for years by surgeons in the open reduction of the fractured patella. At the present time the basic principle of the operative procedure is the approximation of the fragments and surrounding soft tissue and their fixation by the use of absorbent and nonabsorbent material. The results, generally speaking, have been very satisfactory but in a certain percentage of cases, due to poor osteogenetic properties of the patella, delayed or nonunion has occurred, necessitating further surgery. Likewise in the conservative treatment, as shown by John Cowan, nonunion not infrequently is the result of interposition of the tendinofibrous capsule between the patellar fragments.

It has been the occasional experience of surgeons to find in individuals upon whom they have operated for fractures of the patella that a relatively long period of disability results. At times even in those cases in which solid bony union has been obtained, there is a certain amount of permanent disability. This has been largely due to the fact that there has occurred post-traumatic disturbance on the articular surface of the patella either as a result of traumatic arthritis or as the result of some inexactness in the alignment of the fragments, producing a jog or irregularity along the fracture line.

In addition, in some cases union may be unusually slow, necessitating a long period of immobilization. As a result marked stiffness in the knee joint associated with atrophy and weakness in the quadriceps muscle occurs, and the disability of the patient may be definitely protracted.

In 1935, J. E. M. Thomson advocated the removal of the small fragments of the patella suturing the tendon directly to the larger fragment. He reported a series of five cases stating that the results in each instance were uniformly satisfactory. Of great interest is the article by R. Brooks published in 1937 in the *British Medical Journal* on treatment of fractures of the patella by excision. In his article he states that the patella is part of the skeleton phylogenetically inherited and that there is no evidence that its development is in response to a functional need. The patella is not a sesamoid bone and as shown by previous observers is not situated or developed in the quadriceps tendon but is

* From the Orthopedic Service Mount Zion Hospital, San Francisco. Read before the Section on Industrial Surgery of the California Medical Association at Coronado, California, May 6 to 9, 1940.

independent behind the tendon. Brooks further states that the patella has an inhibitory action on motion in the knee and that in fast moving animals as the fox, deer and leopard the bone is small, while in slow moving animals such as sloths and moles the bone is massive and proportionately well developed. The quadriceps muscle itself has no influence on the development of the patella and in the kangaroo, in which the quadriceps is markedly developed, the patella is completely absent.

Through experimentation he advanced evidence that in the absence of the patella the efficiency of the knee joint in man is actually increased. Brooks, in his article, advocates the total removal of the fractured patella and reports a series of cases with very satisfactory results.

Hey Groves, of Bristol, in commenting on Brooks' article, in which he admits his reaction was one of "frank incredulity," following a personal review of the cases, found that claims of Mr. Brooks having restored these people to complete functional activities by excision of the patella were fully justified. He convinced himself of the rationality of this treatment by anatomical investigation in which it was shown that the lateral expansions of the quadriceps tendon to either side of the patella are the essential part of the tendon requiring repair following fractures of the patella. In severe transverse fractures of the patella these lateral expansions of the quadriceps tendon are torn and he believed that with the removal of the fractured patella a much firmer and more complete repair of the torn tendon could be made.

The works of Brooks and Tippet have been mentioned in some detail in this paper in order to emphasize the radical procedure which is now being advocated in treatment of fractures of the patella. The excision of the entire patella would appear to be an extremely radical procedure particularly to the majority of surgeons who have been treating fractures of the patella according to acceptable routine methods and who

have been trained to conserve any damaged tissue that is likely to survive.

Anatomical replacement is an essential step to restoration of function and we are reluctant to accept any extremely radical procedure until this procedure is verified by sufficient clinical evidence. We, in our series, have not as yet employed total excision of the patella in treatment of fractures of this bone but we have for a number of years used the method of partial excision of the fragments with suture of the patellar tendon directly to the proximal fragment. The type of fracture has varied from the simple transverse fracture in which there are two large fragments, to the more common type in which there is one large upper fragment and several comminuted lower or distal fragments. This latter type of fracture is frequently seen as the result of automobile accidents in which the knee of the occupant is brought violently against the instrument panel, the so-called dashboard fracture.

OPERATIVE TECHNIC

We have performed this operation under general, local and spinal anaesthesia and the use of a tourniquet is not necessary as hemostasis is easily controlled. The elliptical incision below the patella is in our experience the best method of approach. On exposure of the patella (Fig. 1) the lower fragment or fragments are cut away from the tendon, care being taken to disturb the tendon as little as possible. Likewise the operative field is scrutinized for small bony fragments and blood clots, removal of which are essential. The upper fragment is carefully inspected for intactness and with a rongeur the edges are smoothed and rounded. With a chisel or sharp elevator the fibrotendinous layer on the superior surface of the patella is elevated without disturbing its intactness. Three holes (Fig. 2) are then drilled equidistant through the upper surface of the patella downward and forward to emerge on the fractured surface of the fragment just above the articulating cartilage. All

frayed and shredded portions of the patellar tendon are cut away and the tendon affixed to the fragment by means of two mattress

that a foreign body reaction to silk necessitated the removal of several sutures. Our experience with stainless steel wire has

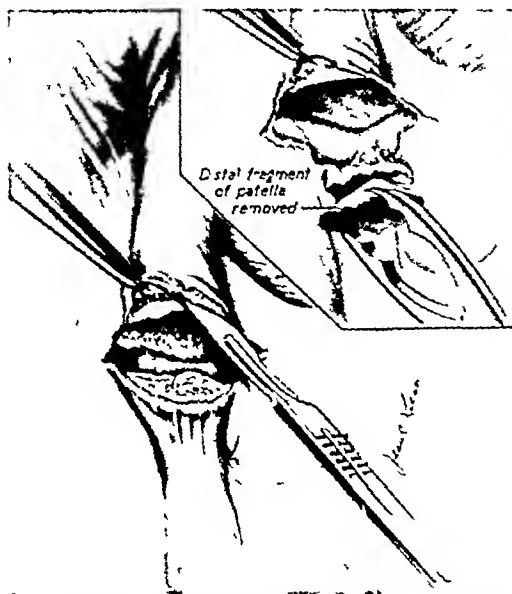


FIG. 1. Removal of distal fragment; elevation of fibrotendinous layer superior surface of proximal fragment.

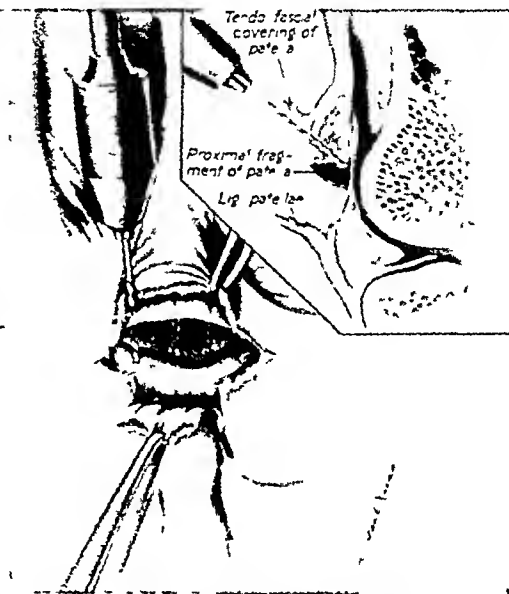


FIG. 2. Drilling of holes through proximal fragment; isolation of proximal portion of patella tendon.

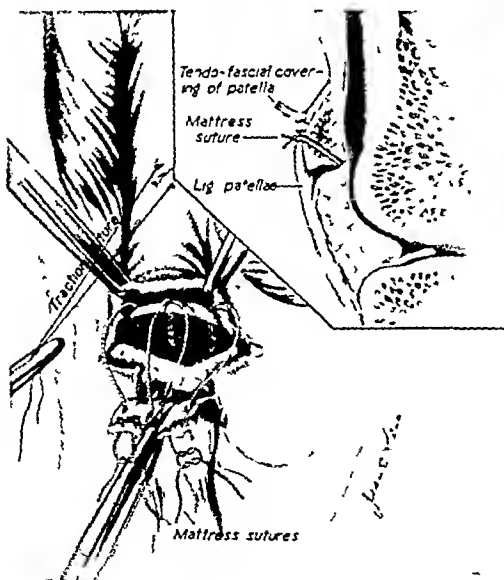


FIG. 3. Placement of mattress sutures.

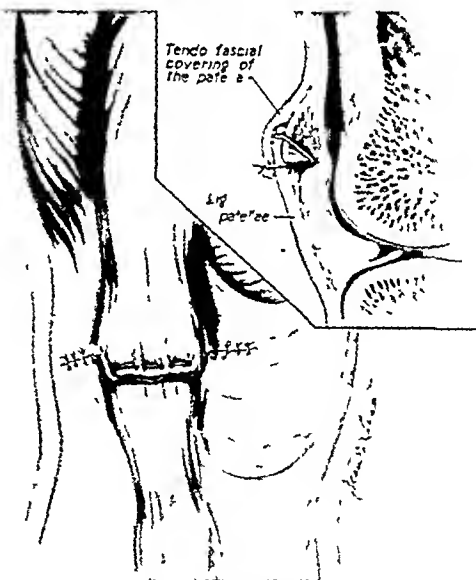


FIG. 4. Placement of sutures to close layer.

sutures employed in such a fashion that the tied knots lie on the superior surface of the patella. (Fig. 3.)

In our early cases we used silk but we now use No. 2 or No. 3 chromicized catgut. It was found, occasionally, several months after the operation, with primary healing,

been limited, but this suture material may be ideal for this procedure. The fibrotendinous layer over the patella (Fig. 4) is then attached by means of interrupted mattress sutures to the patellar tendon itself, the fascia overlapping the tendon. The lateral portions of the tendon and

capsule on either side of the patellar fragment should be carefully approximated by interrupted sutures. The operation can be

the knee is immobilized with either a light cast or posterior metal splint extending from the upper third of the thigh to the



FIG. 5. Fractured patella preoperatively.



FIG. 6. Fractured patella postoperatively.



FIG. 7. Incomplete union with malposition of patella fragments preoperatively.



FIG. 8. Postoperative appearance.

greatly facilitated by affixing a temporary guy suture of braided silk to the quadriceps tendon just above the patella. (Fig. 3.) Traction on this silk strand by an assistant permits easy approximation of the patellar fragment to the tendon during the process of suturing. Following closure of the wound

lower third of the calf. This splint or cast may be removed in two or three weeks and replaced by an ace bandage. In our early cases a splinting support was used for several weeks but we learned that the convalescent period could be shortened by early weight bearing and exercising of the

knee joint. We now allow the patient to walk in ten to twelve days and permit joint motion in the third week.

In our series of fourteen cases the results have been uniformly satisfactory. The majority of our cases is comprised of simple or slightly comminuted fractures of the patella. (Figs. 5 and 6.) In one case, however, as the result of a severely compounded fracture of the patella with loss of the upper half, a satisfactory, stable and painless knee was subsequently obtained by fixing the quadriceps tendon to the distal fragment. Excellent extension with flexion past 90 degrees was obtained, ultimate complete recovery being prevented by some damage to the knee joint itself and the long period of preoperative immobilization. I believe in cases of this type as well as cases of severely comminuted fractures of the patella, that the excision of the entire patella would be the rational procedure. The operation is also of value in those cases of malunion or nonunion of the patella in which painful symptoms in the knee joint persist. In one of our cases with marked deformity of the patella resulting from mal- and incomplete union of the patellar fragments (Figs. 7 and 8) an excellent result was obtained by removing the distal fragment and suturing the patellar tendon to the proximal fragment.

Satisfactory results of the operation or rapidity of convalescence has in no way

been jeopardized by late operative interference which has been necessary in a limited number of our cases due to superficial trauma about the knee joint. Following our operation the contour of the knee joint is not appreciably changed by removal of the patellar fragment or fragments. In addition the presence of the patella as a protective mechanism of the knee and the articular surface of the femur is maintained. This may be of considerable importance in those individuals whose occupations require constant kneeling.

CONCLUSIONS

1. Partial excision of the patella for fracture with restoration of the extensor apparatus of the knee by suture of the patellar tendon to the proximal fragment has given uniformly satisfactory results.
2. The period of disability is definitely shortened with rapid restoration of function in all uncomplicated cases.
3. The uncertainty of union due to the low osteogenic properties of the patella and the protracted disabilities that may result from the long period of immobilization necessary to obtain union is obviated.

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THE DARRACH OPERATION FOR LOWER RADIO-ULNAR DERANGEMENT*

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IN 1936, in a volume dedicated to Dr. Albin Lambotte of Brussels, Dr. William Darrach described an operative

INDICATIONS

The operation was devised for any condition which interfered with the normal



FIG. 1.

FIG. 2.



FIG. 3.

FIG. 4.

FIGS. 1, 2, 3 AND 4. Case 1. Preoperative views showing typical Madelung's deformity.

procedure for restoring derangement of the lower radio-ulnar relationship, which merits a much wider use than now is accorded it. articular relationship of the radius and ulna at the wrist joint. The author noted in his original article the fact that any injury

* From the Service of Dr. Paul C. Colonna.

of the radius resulting in its shortening will produce pain, limitation of motion and often deformity at the wrist. This is seen

ulna. For instance, this is seen most strikingly in Madelung's deformity.

We have found the Darrach operation of

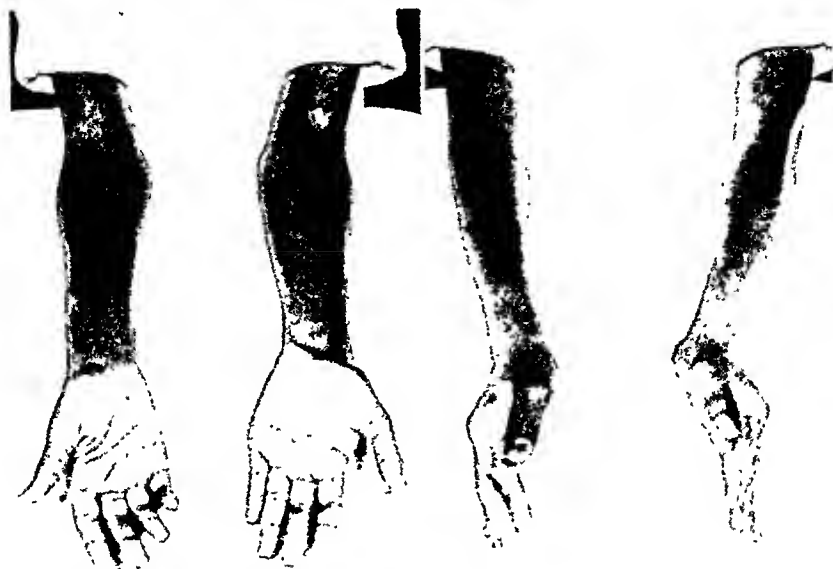


FIG. 5.

FIG. 6.



FIG. 7.



FIG. 8.

FIGS. 5, 6, 7 AND 8. Case 1. Postoperative views taken approximately four months following the last operative procedure.

most frequently following Colles' fracture with impaction, fractures of the shaft of the radius that heal with overriding or angulation and dislocations of the wrist in which reduction has been delayed. Likewise, a similar wrist deformity is produced by disease or injury of the radial epiphysis with maldevelopment of the epiphyseal structure and continued growth of the

extreme value in correcting these wrist deformities as shown by the following patients treated on the Orthopaedic Service at the University Hospital.

TECHNIC

The operation is as follows: An incision is made longitudinally on the ulnar aspect of the forearm, extending from the tip of

the ulnar styloid upward. The incision is carried down to the periosteum between the flexor and extensor carpi-ulnaris ten-

subluxation posteriorly of the head of the ulna and bowing anteriorly of the radius. Styloids of both bones were on the same level. There was

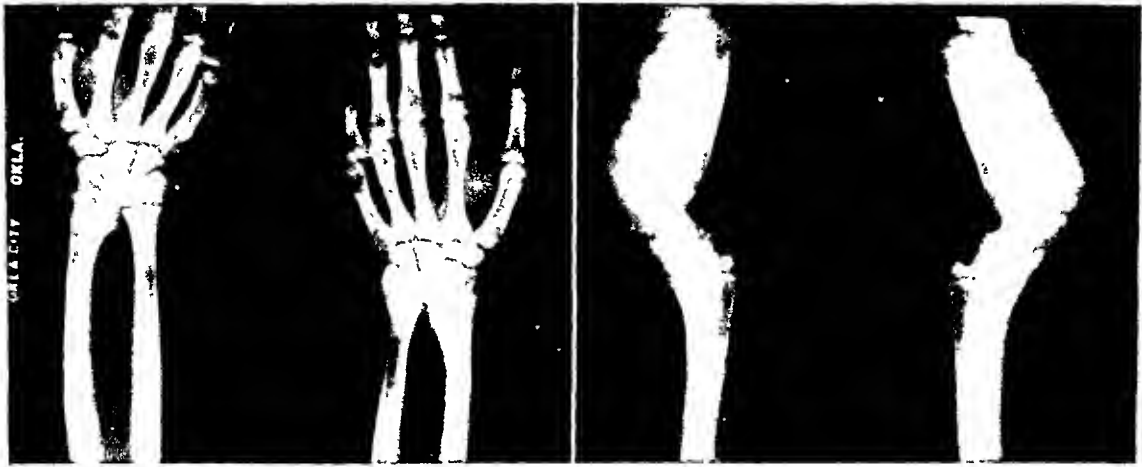


FIG. 9.

FIG. 10.

FIGS. 9 AND 10. Case 1. Anteroposterior and lateral views of both wrists preoperatively.

dons. Care must be taken to avoid the dorsal branch of the ulnar nerve. The periosteum is then reflected from the lower portion of the ulna and the bone is cut across obliquely, leaving a sloping margin to the proximal fragment. The lower fragment is then turned out of the wound and the attachment of the capsule can be divided close to the articular cartilage. The ulnar styloid is then cut across at its base and left behind with its attached collateral ligament. The periosteum is then closed and will provide an attachment strong enough to prevent abduction laxity. Regeneration of bone in the periosteal sleeve varies.

CASE REPORTS

The following cases are presented to show the efficacy of this operation:

CASE I. M. M., a colored female, age fourteen years, was first seen in the Out-Patient-Department on February 17, 1940. The patient complained of a deformity of both wrists and forearms which was associated with increasing weakness and pain. There had been no attempt at treatment and she stated that she had not been conscious of her condition until three years previously.

Examination revealed the typical deformity of Madelung with marked prominence and

the usual limitation of dorsiflexion of the hands and supination of the forearm. Radial deviation was definitely limited by bony block, but ulnar deviation was normal.

On February 24, 1940, the Darrach procedure was carried out on the right ulna and, through a second incision, a wedge osteotomy was done through the distal epiphyseal plate of the radius. Postoperative x-rays showed satisfactory correction of the deformity, but an osteotomy two inches above the first was decided upon to correct completely the bowing of the radius. This was done March 16, 1940, and postoperative x-ray showed excellent correction of the deformity. The left wrist was operated upon on May 18, 1940, the Darrach operation being combined with an osteotomy of the radius, done at the point of greatest bowing.

The patient was last seen in the Out-Patient-Department on June 25, 1940, at which time both wrists showed a good cosmetic and functional result, with solid bony union at the site of the osteotomies.

CASE II. C. M., a white male, twenty-seven years of age, was first seen in the Out-Patient-Department on July 6, 1940, complaining of loss of grip in the hand, pain and deformity of the wrist. The patient sustained a fracture of the right radius September 26, 1939, while cranking a car. An open reduction was performed, at another hospital, on September 29, 1939.



FIG. 11.



FIG. 12.

FIGS. 11 AND 12. Case 1. Anteroposterior views of both wrists approximately four months following completion of the last operative procedure. Note the regeneration of bone and the periosteal sleeve of the right ulna.



FIG. 13. Case 11. Anterior and posterior views of the right forearm as taken on first admission to the hospital. Note the marked radial deviation of the hand and also of the distal end of the ulna.



FIG. 14. Case 11. Anterior and posterior views which were taken six weeks postoperatively. There is complete correction of the radial deviation of the hand.

Examination revealed that the hand deviated markedly toward the radial side. There was evident shortening of the radius with nonunion about two inches proximal to the styloid process in the shaft of the radius. The lower extremity of the ulna was prominent and was evidently dislocated from its articulation with the radius. Rotation was restricted about 50 per cent and the forearm was held in an attitude of pronation. There was no disturbance of muscle power, but the grip was weak because of mechanical malposition.

On July 9, 1940, a Darrach type operation was done on the right ulna, an open reduction of the radius was performed and a plate ap-

plied. Postoperative x-rays showed a good correction.

The patient was last seen on August 14, 1940 at which time the hand was in excellent position.

CONCLUSION

The Darrach operation is an excellent operative procedure and one that will be found most valuable in correcting disturbances of the lower radio-ulnar relationship.

REFERENCE

- DARRACH, WILLIAM. Derangements of the inferior radio-ulnar articulation. Livre Jubilaire offert au Docteur Albin Lambotte, 147, 1936.



THIS disease (poliomyelitis) affects primarily the central nervous system. Although there is diffuse and usually extensive involvement throughout the brain and spinal cord, it appears that the virus has a peculiar affinity for the motor nerve cells of the cord, particularly the cells of the lumbar and cervical regions.

ACUTE APPENDICITIS IN YOUTH AND OLD AGE*

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ACUTE appendicitis in youth and old age is of far greater diagnostic and therapeutic importance than the number of patients so afflicted would indicate, because a disproportionately large percentage of the total number of deaths from acute appendicitis occur in the extremes of life. Our experience has been similar to that of others in that the mortality rate of acute appendicitis has been highest in those ages in which the incidence has been least and vice versa. It may be on account of this very scarcity of acute appendicitis in patients less than ten or more than sixty years of age that there is such a high mortality rate in these ages. In these patients acute appendicitis may not even be considered as a possible cause of abdominal pain.

Acute appendicitis is most frequently encountered in adolescence and early adult life, but it does occur in every decade with sufficient frequency to be of diagnostic and therapeutic importance throughout the life span. It has been reported in an infant of twelve days by Ham¹ and in an infant of three weeks by Pope.² In our experience the incidence has increased steadily with increasing age until a peak was reached about the twentieth year; thereafter it decreases slowly. (Fig. 1.)

We have encountered patients more than eighty and less than two years of age with this disease. Of 1,039 consecutive patients with acute appendicitis previously reviewed¹⁴ there were one hundred of either less than ten or more than sixty years of age, or 9.6 per cent of the total number. Of this one hundred patients, sixteen died, or a mortality rate of 16 per cent. Of the 939 patients between ten and sixty years of age,

137 died, or a mortality rate of 4.2 per cent. To express it differently, 29 per cent of the total number of deaths from acute appendicitis and its complications occurred in patients of less than ten or more than sixty years of age, although this group formed less than 10 per cent of the total number.

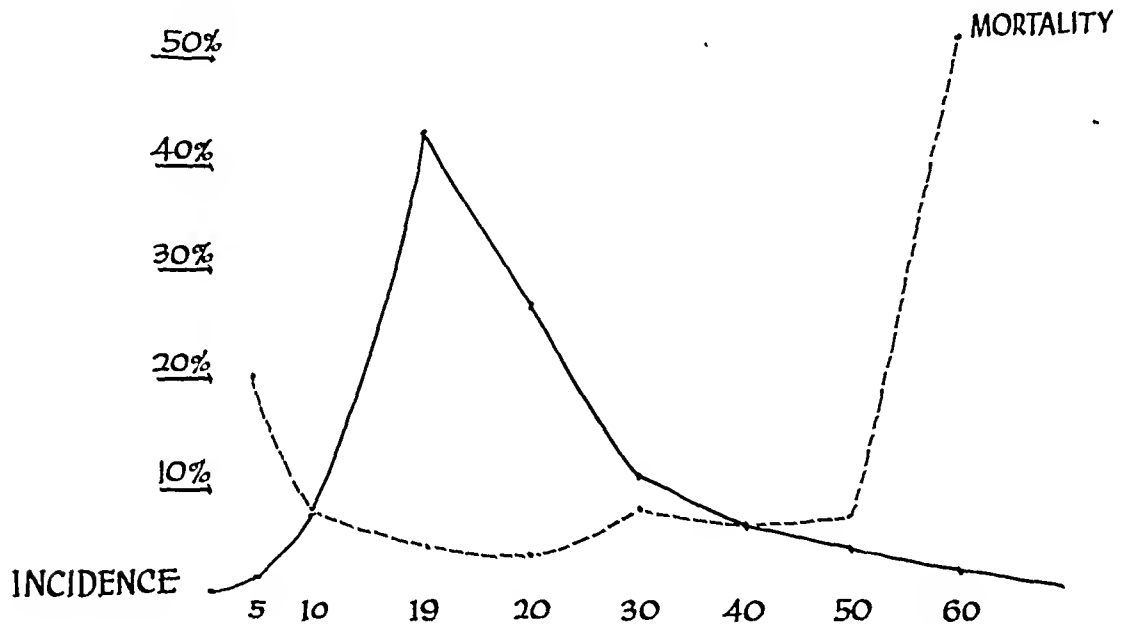
Similar findings have been reported in the literature. For example, Pattison³ found that over 40 per cent of the deaths from acute appendicitis occurred in the extremes of life. Cole⁴ reported a mortality rate in children (7.9 per cent) with appendicitis (acute and chronic) almost four times that in adults (2.16 per cent). Stone⁵ reported similar findings. Allen⁶ reported a mortality rate of 15.27 per cent in infants. Collins⁷ noted that "The mortality rate (of acute appendicitis) increased appreciably in the first and after the fifth decade of life." Koonce⁸ found the mortality rate of acute appendicitis 12 per cent in the first decade, 1 per cent in the third decade and 42 per cent in the seventh decade. Keyes⁹ and Bower¹⁰ report essentially similar findings.

In our experience the mortality rate associated with acute appendicitis in every age group has been more closely related to the incidence of appendiceal peritonitis than any other single factor. (Fig. 2.) Death of patients with acute appendicitis operated upon prior to perforation of the vermiform process has been rare. Of the one hundred patients less than ten or more than sixty years of age considered here, forty-one or 41 per cent had appendiceal pus in the peritoneal cavity at the time of entry at the hospital. In patients with acute appendicitis between ten and sixty years of age, 14.5 per cent had appendiceal peritonitis. In our

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opinion the high mortality rate associated with acute appendicitis in youth and old age is dependent upon the high incidence

ther analyzed by the percentage of patients with appendiceal peritonitis in respect to the time elapsing between onset of symp-



AGE INCIDENCE and MORTALITY of ACUTE APPENDICITIS

FIG. 1.

of appendiceal peritonitis encountered in these patients. If every acutely inflamed appendix had been removed prior to perforation, regardless of the age of the patient, death from acute appendicitis would have been rare.

The factors responsible for this high incidence of perforation and indirectly the high mortality rate in the very young or the very old patient with acute appendicitis, as elsewhere, seems to be first, delay in treatment, and second, catharsis. An analysis of these patients does not support the belief that perforation occurs more rapidly in youthful patients. In patients of all ages with acute appendicitis, perforation had occurred in 4 per cent of the patients seen within twenty-four hours after the onset of symptoms; in children under ten, perforation had occurred in 6 per cent of the patients less than ten years of age seen within twenty-four hours of the onset of symptoms. In view of the small number of patients in each of these groups it is doubtful that this difference is of statistical significance. When these patients are fur-

toms and hospitalization in the two groups of patients (youth and old age versus adolescence and early adult life) there is but little difference. (Fig. 3.) The sole cause of the increased incidence of appendiceal peritonitis and the increased mortality in youth and old age is apparently the greater interval which elapses, on the average, between the onset of symptoms and the institution of correct therapy. (Fig. 4.)

Why delay in hospitalization should be encountered more frequently in youth and old age than elsewhere is not entirely clear, but there are several factors which seem to play a part. In the first place, delay in the institution of treatment may be occasioned by failure of the patient or his family to summon medical aid, a failing particularly easy to understand in youth and old age when one remembers the frequency of abdominal pain arising from self limited disease in these age groups. In adolescence and early adult life, acute appendicitis is one of the more frequent causes of abdominal discomfort; and abdominal pain, regardless of its origin, immediately suggests

acute appendicitis to the patient and his family. In children, on the other hand, "green apple colic," gastroenteritis, mesen-

relieving most types of abdominal pain in children and may have been prescribed at one time or another by a physician. Condi-

<u>Age</u>	<u>Mort. Entire Group</u>	<u>Per Cent Perf.</u>	<u>Mort. Perf.</u>	<u>Mort. Unperf.</u>
0-4	18%	73	25%	0
5-9	7%	25.3	27%	0
10-19	3.6%	14.6	25%	0
20-29	3.2%	12	15.6%	1.5%
30-39	7.6%	16	36.8%	2%
40-49	5.5%	24	23%	0
50-59	6%	27	22%	0
60-Plus	50%	77.2	60%	0

ANALYSIS of PATIENTS *with* ACUTE APPENDICITIS *by* AGE GROUPS

FIG. 2.

teric adenitis, or the acute exanthemas are much more frequent causes of abdominal pain than acute appendicitis and the former are first suspected as the cause of the patient's complaints—acute appendicitis usually only after complications have occurred. Only by *continuous* suspicion on the part of the patient's family and *repeated* examination by the physician can such mistakes be avoided.

This frequency of abdominal pain due to self limited disease in children has another and no less important effect. When medical aid has been summoned two or three times for abdominal pain which was not appendiceal in origin, the family soon becomes reluctant to call a physician for a complaint which seems similar to that suffered previously, although the cause may be entirely different. In other instances, catharsis has been found to be an effective method of

tioned by these experiences it is not unnatural that when abdominal pain comes again, even though it may be due to acute appendicitis, for the family to understandably hesitate to call a physician and they may even administer a purgative. In patients less than five years of age perforation of the vermiform appendix had occurred in 73 per cent at the time of entry at the hospital.

In elderly patients the same situation has been found to exist. In these patients, obstipation and dyspepsia are much more frequent causes of abdominal discomfort than acute appendicitis. Indeed, some elderly patients have almost continuous mild abdominal discomfort which they have learned to disregard entirely. Added to this, in patients past sixty, sensibility to abdominal pain is apparently reduced and, therefore, the clinical manifestations of

acute appendicitis have been more easily ignored. It is no surprise that the vermiform appendix is rarely suspected as the cause of

rotomy, and only by the frequent use of exploratory laparotomy in patients with "suspected acute appendicitis" can many

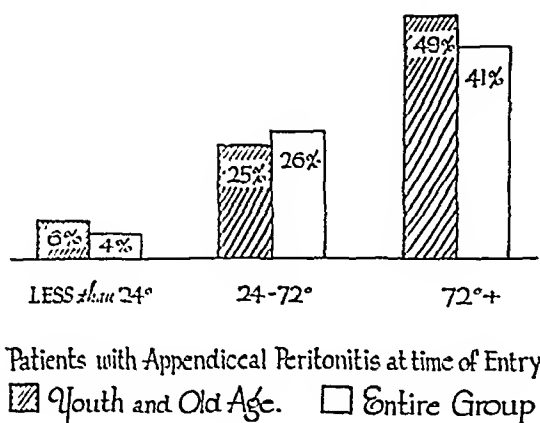


FIG. 3.

an elderly patient's discomfort until the disease is far advanced. Perforation of the appendix had already occurred at the time of entry in 77.2 per cent of the patients past sixty years of age with acute appendicitis. Abdominal pain at any age may be due to acute appendicitis, and in our opinion should be so considered until proved otherwise by exploratory laparotomy, if necessary, regardless of the age of the patient.

In the second place, increased difficulty in differential diagnosis in the very young and the very old patient with abdominal pain probably contributes to delay in hospitalization and the high incidence of appendiceal peritonitis. In our experience, in only approximately 50 per cent of all patients of all ages with acute appendicitis can the diagnosis be made with certainty from the history, physical examination and the laboratory findings. In the remaining one-half of the patients, the diagnosis of "acute appendicitis" must be made by exclusion of other conditions which might be responsible for the patient's complaints. This may be a very simple procedure in the young man of eighteen but rapidly becomes more difficult as the extremes of life are approached. In youth and old age there are many pathologic conditions, commonly encountered, which may prove confusing. In many instances it is impossible to settle the diagnosis except by exploratory lapa-

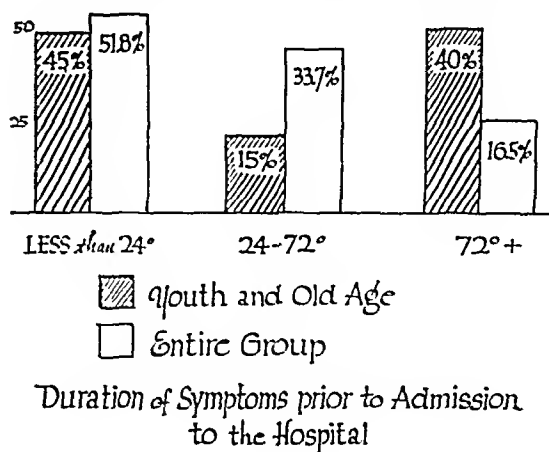


FIG. 4.

patients be saved the dangers and discomfort of appendiceal peritonitis. When it is impossible to exclude the vermiform appendix as the cause of the patient's distress, in our opinion exploratory laparotomy is not only justifiable but is mandatory. The child of seven who develops the rash of measles on his first postoperative day will recover. The patient with mesenteric adenitis is benefited by the removal of the appendix. In the same way, the life of the older individual in whom the appendix does not prove to be the cause of his symptoms has been jeopardized but little by exploratory laparotomy. On the other hand, had these patients been allowed to retain an acutely inflamed appendix—and the symptoms may, at times, be such that exact diagnosis is impossible—serious sequelae are to be expected. The free use of exploratory laparotomy, in our experience, has been the only possible way to avert tragedy in certain patients with acute appendicitis. In those patients in which the appendix was not at fault, there was not a single death and the stay in the hospital was less than ten days with few exceptions. Exploratory laparotomy in these patients was a matter of inconvenience, not of danger. On the other hand, in six patients with acute appendicitis who were treated on nonsurgical wards due to an error in diagnosis there was a mortality rate of 100 per cent. In-

deed, there is nothing which offers the patient with acute appendicitis so poor an outlook as a persistent error in diagnosis.

It is true that in youth and old age acute appendicitis may prove to be the cause of abdominal pain less frequently than in young adults, but we believe that exploratory laparotomy should be undertaken on the same indications in these age groups as in others, i.e., inability to rule out the vermiform appendix as the cause of the patient's discomfort. It is better to perform exploratory laparotomies on several patients without acute appendicitis than to allow one patient to go on to perforation. Let us repeat, that not a single death occurred in any age group in which exploratory laparotomy failed to reveal an acutely inflamed appendix as the cause of the patient's symptoms.

In our opinion, the treatment of patients with acute appendicitis in the extremes of life should, with few exceptions,^{13,14} follow those principles already found most satisfactory in other age groups. Ideally, this consists in removal of the appendix before infection has spread beyond its confines. When the process has spread to the peritoneal cavity and localized abscess has occurred, we agree with Lehman and Parker,¹¹ among others, that supportive measures are preferable to immediate surgery unless active interference is demanded by a progressively rising pulse or increasing fever. In instances in which a localized abscess had formed in children, Miller, Fell, and Brock¹² found that resolution occurred in 89 per cent without surgical interference, and it was possible to remove the appendix during a quiescent stage.

In patients with generalized peritonitis there is the greatest difference of opinion in regard to the most satisfactory treatment. In our experience, whether or not immediate or delayed surgery has been undertaken, it is of the utmost importance to institute promptly and carry out faithfully those measures designed to correct the derangements in normal physiology^{13,14}

which consistently occur in these patients. These have been outlined previously in detail elsewhere.¹⁵ One of the most important of these is physical rest for the patient, which may be obtained only with difficulty in the very young patient.

CONCLUSIONS

1. The mortality rate of acute appendicitis in youth and old age has been approximately four times the mortality rate in adolescence and early adult life.

2. This increased mortality rate in youth and old age does not seem to be due to a peculiarity of the disease itself in these age groups but rather to the greater delay encountered, on the average, in the institution of treatment, and a consequent increase in the incidence of appendiceal peritonitis.

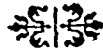
3. In our experience, this delay in the institution of treatment in patients with acute appendicitis in youth and old age has been due first to reluctance of the patient or his family to summon medical attention due to previous experience with self limited disease associated with abdominal pain which seem similar to that of acute appendicitis, and second, increased difficulty in differential diagnosis in these age groups.

4. Constant suspicion of the appendix as a cause of abdominal pain at any age by family and physician as well as more frequent exploratory laparotomy in patients in whom the diagnosis is doubtful are suggested.

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THE pathological changes (in poliomyelitis) most commonly involve the lower motor neurons. This fact is demonstrated clinically by flaccidity of the muscles of one or both legs, one or both arms, both arms and legs, arms and trunk, legs and trunk, trunk alone, or the whole body. Paralysis rarely involves the upper motor neurons and rarely produces spasticity.

A METHOD FOR PREVENTING OR DIMINISHING PERITONITIS FROM LEAKAGE AFTER INTESTINAL RESECTION OR PERFORATION

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CASE 1. A female patient, aged twenty-seven, with tuberculosis of the cecum had a resection of the terminal ileum, cecum and ascending colon with an ileotransverse colostomy on May 28, 1940. The anastomosis (three layers) was easily done on normal healthy bowel and seemed perfectly satisfactory. On the third day after operation the temperature was at 101°F. all day. On the fourth day it began to rise reaching 102.5°F. On the fifth day it rose to 103.8°F. She began to vomit, developed distention, tenderness and rigidity in the abdomen, and expired on the sixth day.

The postmortem findings were: Feces in the peritoneal cavity from a leak on the anterior surface of the ileotransverse colostomy through which a probe could easily be passed into the bowel lumen. (Fig. 1.)

In recent years many methods have been devised to perform anastomosis of various parts of the gastrointestinal tract aseptically so as to diminish the mortality resulting from the peritonitis attendant upon infection by spill of content. Yet peritonitis following leakage from a suture line, even after an aseptic anastomosis has been performed, still exacts a heavy toll. Continuous seepage of bowel content into the peritoneal cavity beginning hours or days after the abdomen has been closed on what seemed to be a perfect anastomosis is responsible for most deaths from peritonitis after intestinal resection, and not the soiling at the time of operation. The peritoneum withstands the average operative soiling easily. In this respect its ability to protect itself may be likened to the ability of the blood to free itself from bacteria

unless a fairly continuous supply from an open focus is maintained.

This dangerous complication can be avoided by the simple expedient of exteriorizing the anastomosis and closing the wound around it.¹ Within a few hours the peritoneal cavity is sealed. If leakage occurs subsequently, the peritoneum is safe from infection and the suture line can be repaired electively. When it is certain that the bowel junction has completely healed, the exteriorized bowel may safely be returned to the peritoneal cavity. This principle applies to the entire intestinal tract excepting the rectum and rectosigmoid and may also be applicable in occasional instances to gastric anastomosis.

This procedure has as yet not been done often enough to determine whether or not all exteriorizable anastomosis should be so treated. However, the case just cited demonstrates the lack of suitable criteria for establishing the safety of an anastomosis. It is obvious, however, that in any instance in which there is reason to doubt the security of the anastomosis and to fear leakage, a very important safeguard can be given the patient by exteriorizing the questionable loop of bowel, until definite assurance is obtained that leakage will not occur. If leakage is to occur, let it occur outside the peritoneal cavity.

The same principle is applicable also to certain perforated localized lesions of the exteriorizable portion of the gastrointestinal tract. In such cases, if it is not possible to close the perforation, or if after closure the security of the suture line is doubted, as for example in perforated diverticulitis

with marked induration, exteriorization prevents increasing the already existent peritonitis. Then when the perforation has closed spontaneously (Case II) or after subsequent suture (Case IV), the loop is repositioned in the peritoneal cavity.

TECHNIC

After the anastomosis has been completed it is wrapped in a lap sponge and held out of the abdomen. It is preferable to have it protrude at one of the angles of the wound, but occasionally intraperitoneal attachments will necessitate its protrusion through the middle. In either case the wound is closed around the protruding bowel in the usual manner. The bowel is then loosely wrapped in saline-wetted gauze covered by rubber tissue, and the dressings are fixed to the abdominal wall by adhesive. The dressings are changed daily until reposition is decided upon. The exteriorized bowel is thoroughly washed with normal saline solution. The abdominal wall is dried and painted with an antiseptic solution, (our preference is for 6 per cent picric acid in 50 per cent alcohol and 10 per cent acetone), and the loop is freed from the margins of the incision by a combination of sharp and blunt gauze dissection. It is dropped into the cavity and the wound is closed by a few through-and-through sutures of black silk.

In the case of a perforation of the bowel the involved loop is similarly exteriorized and the wound closed loosely around it. Occasionally, (Fig. 2) it will be found advantageous to pass a glass rod through the mesentery of the loop to facilitate maintaining it outside the abdominal cavity.

Brief abstracts of operative procedures illustrating the use of this method in various conditions, e.g., diverticulitis of the sigmoid colon, appendicitis, resection of small bowel, resection of large bowel are presented as illustrative of the fourteen cases in which we used this method.

CASE II. A male, aged fifty-two, was operated upon with the provisional diagnosis of

perforation of the sigmoid from carcinoma or diverticulitis. Through a left lower rectus incision the sigmoid was found adherent to the



FIG. 1. Anastomosis showing probe passing into bowel lumen through a defect from which continuous leakage produced a fatal peritonitis (after immersion in formalin).

left pelvic wall and covered by adherent omentum, walling off a perforation of a sloughed off diverticulum. The bowel around the gangrenous perforation was markedly indurated and could not be closed by suture. The sigmoid was mobilized by cutting the outer leaf of its peritoneal attachment to the posterior abdominal wall, exteriorized and held out of the abdomen on a glass rod placed through its mesentery. Three strips of wet gauze were used to pack off this loop from the peritoneal cavity and the wound closed around the loop and gauze. The exposed bowel was covered with saline-moistened gauze and rubber tissue to prevent drying by evaporation. The fluid balance was adequately maintained, and the dressings changed daily, and after a stormy course for four days he convalesced satisfactorily. The exposed bowel became covered by a slightly yellowish exudate which was kept at a minimum by normal saline wet dressings. Feces continued to discharge from the perforation which became progressively smaller until on the seventeenth day it was completely closed. Two ounces each of water and glycerin used as a retention enema was effectual on the fourth day following operation, and thereafter bowel movements were obtained either by mineral oil, enemas as above or both. On the sixth day all gauze pack-

ings were removed. On the fourteenth day the glass rod was removed. On the fifteenth day a tendency for the sigmoid to recede into the

struction by angulating the contiguous bowel. The cyst and about six inches of bowel were resected and an end-to-end anastomosis was

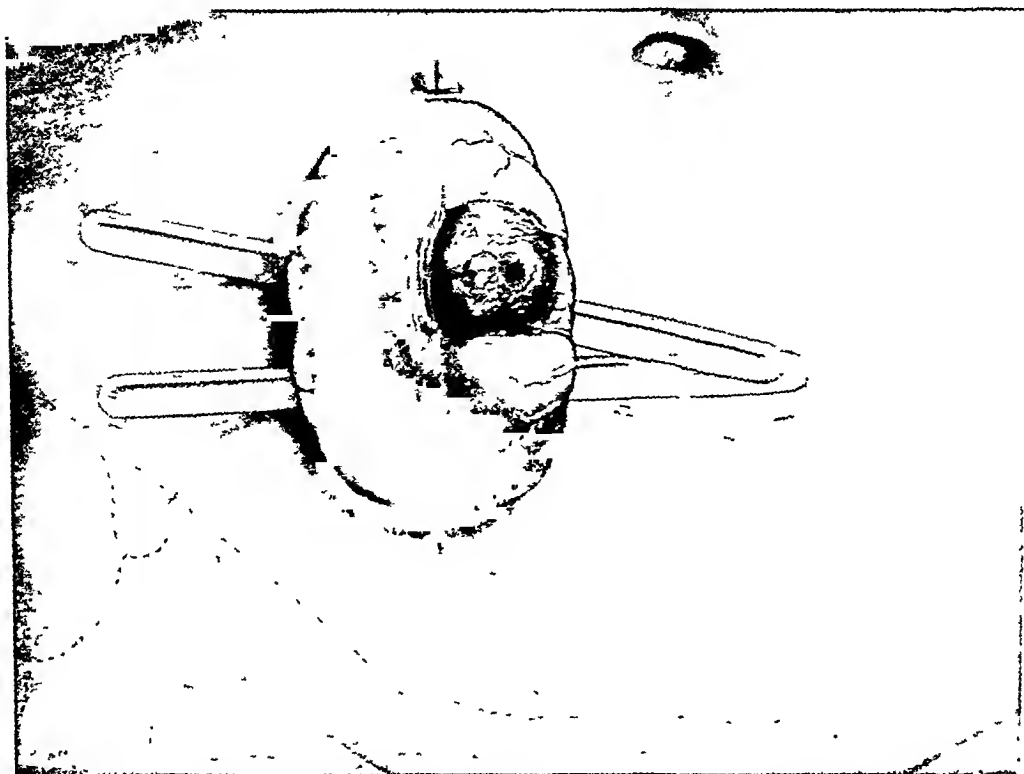


FIG. 2. Exteriorized loop of sigmoid with a perforated diverticulitis.

abdominal cavity was noticed. The recession progressed very slowly. The temperature was normal. On the twenty-fifth day after washing the loop of bowel with saline and then preparing the surrounding skin, the loop was dissected free from the abdominal wall and repositioned in the peritoneal cavity. During the dissection dense adhesions of the ileum to the abdominal scar were encountered and in their separation the ileum was torn. Four inches of ileum was resected and an end-to-end anastomosis over soft clamps was done and the wound closed. Convalescence was uneventful excepting for a late wound infection which cleared after incision, and the patient was discharged cured on March 11, 1935.

CASE III. A female, age seven, was operated on a provisional diagnosis of acute appendicitis. There was some free serous fluid in the peritoneal cavity. The appendix was found to be but slightly injected and apparently not responsible for the symptoms. A large mesenteric cyst was found near the terminal ileum, which was apparently producing partial intestinal ob-

struction. The bowel for about four inches on either side of the anastomotic opening was left outside the abdomen and the wound closed around it. The bowel was kept protected by moist dressings; gastric distention was kept at a minimum by Wangenstein drainage. One thousand cc. of 5 per cent glucose in normal saline was given parenterally or intravenously twice a day. The temperature which was 103°F. on admission fell to normal in a few days. On the third day postoperatively the patient had a spontaneous bowel movement and thereafter had a bowel movement at least once a day. On the eighth day postoperatively the bowel was washed off with saline and repositioned within the abdominal cavity which was closed without drainage. The patient made an uneventful recovery and was discharged two weeks later on February 2, 1940.

CASE IV. A fourteen year old male was operated upon for acute appendicitis. The appendix was found to be markedly congested and swollen throughout its entire length to about three-fourth inch in diameter. There was also considerable induration of the cecum

around the base of the appendix for a distance of between one-fourth and one-half inch circumferentially. There was a perforation at the base of the mesenteric attachment. The meso-appendix was ligated and the appendix was removed with the portion of the cecum which was indurated, after controlling the fecal current with an intestinal clamp. The cecum was closed by a continuous Connell suture inverting the edges. Because of the induration along the edges, the suture line was not believed to be secure, and the cecum and terminal ileum were exteriorized over a glass rod, and the wound closed with through-and-through silk sutures loosely around the exteriorized bowel. The bowel was protected by moist dressings which were changed daily. On the fourth day after the operation a small area of necrosis at the suture line began to develop, and four days later there was a frank fecal fistula. Bowel movements were regular. Wet dressings were continued in the hope that this fecal fistula would close spontaneously, without success. The induration around the fistulous opening disappeared completely however. On November 12, 1939, the cecum was separated from the abdominal wall and completely mobilized. The edges of the fistula were pared and closed by a Connell suture. This was reinforced by two subsequent layers of sutures and the cecum and terminal ileum were allowed to remain out upon the abdomen and kept protected by moist dressings of saline. The suture line healed and the bowel remained closed. Eight days later the cecum was separated from the abdominal wall and repositioned into the peritoneal cavity. At this time a small abscess was found in the lower angle of the original incision which was evacuated. The wound was closed with through-and-through black silk interrupted sutures. The patient developed an infection of the wound, but wet dressings were sufficient to maintain drainage from the suture holes. The sutures were removed on the 9th day postoperatively. The patient was finally discharged on December 20, 1939, cured.

Failure to exteriorize the bowel in this case might have proved fatal if the necrosis had occurred intraperitoneally and the process had not been spontaneously walled off. The secondary closure was successful, however, because by that time the induration was gone.

CASE V. A fifty-three year old male was operated upon for acute appendicitis. The appendix was slightly inflamed as though by contiguity. There was a mass in the sigmoid about seven inches above the rectosigmoid junction which was lying in the right lower quadrant of the abdomen. It was red, boggy and had fibrin on the surface, and an epiploic tab was adherent to it as though attempting to wall it off from perforating. The lumen of the sigmoid was almost occluded. The large bowel proximal to the mass was distended as was also the visible small bowel. Apparently the lesion was a diverticulitis of the sigmoid which had not yet perforated and the appendix which was lying very close to it was showing signs of inflammation on the serosa through contiguity. The appendix was removed and the mass was exteriorized over two glass rods through the right rectus incision. The mobility of the sigmoid being such as to allow this to be done easily. The wound was closed around the loop of sigmoid which was then protected by wet dressings. Four days later, spontaneous bowel movement had occurred and daily there was a noticeable decrease in the induration of the bowel wall. By the 7th day the texture of the bowel was normal to the touch. On the 10th day a thin pellicle over the exteriorized bowel was removed by pulling it off and the bowel was sprayed with sulfanilamide powder. On the 12th day the sigmoid which seemed completely restored to the normal was freed from adhesions to the abdominal wall and repositioned in the abdominal cavity. There was a slight temperature reaction for a few days and then the patient made an uneventful convalescence. Shortly before repositing the exteriorized loop in the peritoneal cavity a fluoroscopic examination of the exteriorized loop by opaque enema showed that the mixture flowed through the sigmoid without delay. The loop outside the abdominal cavity was readily visualized, but barium passed through this loop much more rapidly than it did through the neighboring portions of the sigmoid, so that at no time was it as well visualized as the proximal or distal loop.

CASE VI. A forty-nine year old male was operated upon for perforated diverticulitis of the sigmoid. A perforation of a diverticulum of the sigmoid was found with free pus in the peritoneal cavity. There was considerable induration of the wall of the sigmoid around

the perforation. The sigmoid was exteriorized over a glass rod passed through the mesentery and the peritoneum was drained with one cigarette and one gauze drain and the wound closed loosely around the exteriorized loop and the two drains with through-and-through black silk sutures. The exteriorized bowel was protected with wet dressings. The temperature was 102.4°F., pulse 104, and respirations 28. The bowel discharged fecal material. The temperature remained elevated for twelve days ranging between 103 and 100°F. daily. The drains were removed on the twelfth day postoperatively. By the sixteenth day the temperature had reached normal. On the twentieth day an attempt was made to close the fecal fistula by inverting the edges with two layers of chromic catgut sutures leaving the loop exteriorized, but two days later the fecal fistula redeveloped. During all this time there was a slow but steady recession of the sigmoid into the abdominal cavity. It was deemed worthwhile merely to continue wet dressings to the wound. The fistulous opening gradually became smaller and smaller until on the forty-sixth day postoperatively the fistulous tract was completely closed spontaneously. The sigmoid had retracted into the abdominal cavity so that only approximately one square inch of granulating surface was still uncovered by epithelium, and on the fifty-second day postoperatively the patient was discharged with the wound entirely healed. In this patient no reposition was attempted at any time. He was seen on May 17, 1940, at which time he had an incisional hernia. When this is repaired it will be possible to inspect the retracted bowel wall.

CASE VII. A female, aged twenty-one, was operated upon for regional enteritis. Laparotomy disclosed a mass of terminal ileum about two feet in length which was inflamed, thickened, spongy and covered with fibrin. The cecum was also involved. The adjacent mesentery was thickened and contained enlarged glands. In the upper ileum and lower jejunum there was a similar lesion involving about four feet of the bowel. There were about five feet of normal intervening intestines. A resection of the terminal two and one-half feet of ileum, cecum, ascending colon to the middle of the transverse colon and a ileocolostomy was performed in three layers. The anastomosis was exteriorized and covered with wet saline dress-

ings and the wound closed around it. The patient reacted well postoperatively except for severe diarrhea which was finally controlled. On April 20, 1940, the bowel was replaced in the abdomen under spinal anesthesia after thoroughly washing it with saline solution. Convalescence was uneventful except for slight stitch abscesses and severe diarrhea, which caused her to lose about thirty pounds before it was finally controlled by bismuth, vitamin B and thick cereal and gelatin feeding. An x-ray of the intestines after barium failed to reveal the lesion in the upper ileum found at operation. She was discharged on May 19, 1940, with the understanding that she would return a month later for treatment of the other intestinal lesion, at which time it will be possible to inspect the repositied anastomosis.

These seven cases are presented as types of lesions in which this operation has been used up to the present time. When the bowel is exteriorized and covered with wet dressings it loses its original appearance within twenty-four hours and the serosa begins to look like granulation tissue. It has a yellowish pink color at first but within a few days takes on a healthy red, slightly bleeding appearance of the kind of granulation tissue one would like to have as a base for a skin graft. In several of our patients in which fistulas developed this granulating surface was contaminated by the fecal current for a good many days. Not only was there no constitutional reaction as a result of absorption from this surface, but apparently the lack of complete sterility at the time that the loop was repositied was not a factor of great importance in determining the character of the convalescence. The question might be raised here as to whether the absorption of infected materials through serous surfaces, which are exteriorized, is different from that of bowel within the peritoneal cavity.

The only opportunity for histologic study of the exteriorized bowel was afforded by a patient who died before the bowel could be replaced.

CASE VIII. A male, aged seventy-one, was operated upon for intestinal obstruction by

what appeared to be a carcinoma at the cecum. It was resected removing terminal ileum, cecum, and colon to the middle of the trans-

verse portion. It has not yet undergone organization. We have as yet not re-operated upon a patient in whom the exteriorized bowel has



FIG. 3. Microphotograph of a section of anastomosis between ileum and transverse colon on the ileal side which had been bathed in feces for over two weeks. There is a layer of granulation tissue on the serosa.

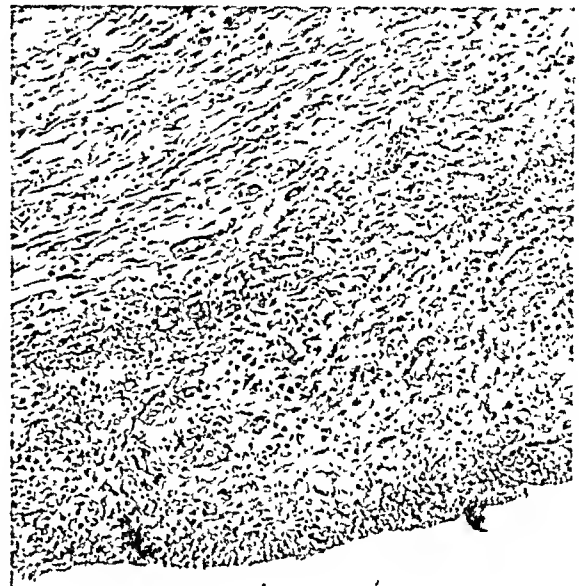


FIG. 4. Higher magnification of portion of serosa marked in Figure 3 showing the cellular exudate. 250 X.

verse portion. An ileocolostomy was performed and the bowel left outside the peritoneal cavity protected by saline dressings. By the fourth day postoperatively the temperature was normal and a spontaneous bowel movement had occurred, but the abdominal wound began showing signs of breakdown. On the seventh day a leak developed at one point of the anastomosis through which feces was discharged. The abdominal wound broke down completely to the peritoneum and the skin began ulcerating. The ulcerous condition of the skin extended centrifugally quite rapidly and the general condition of the patient became progressively worse so that no attempt was made to close the fecal fistula. Supportive measures failed and he died three and one-half weeks after operation. At autopsy there was no sign of peritonitis or intraperitoneal abscess.

Figures 3 and 4 represent the microscopic appearance of a section of the anastomosis between the ileum and transverse colon on the ileal side. This had been bathed in feces for over two weeks. The section shows a thickening of the serosa caused mainly by a deposition of granulation tissue. This tissue is infiltrated by a cellular exudate consisting of histiocytes, lymphocytes, polymorphonuclear leucocytes and other forms. There is a deposit of fibrin on the surface

which has not yet undergone organization. We have as yet not re-operated upon a patient in whom the exteriorized bowel has

been repositioned so that we have had no opportunity to see what happens to the bowel after it has been returned into the peritoneal cavity. There have been three complications which we have encountered: The first, injury to the bowel during reposition occurred once (Case 11). The other complications were infection of the wound and hernia. The infection has taken the form of stitch abscesses or an abscess above or below the fascia. The former responded readily to wet dressings and in the latter the wound was opened to establish drainage. In no case has an abscess been found in the peritoneal cavity. It is also of interest to note that no difficulty was encountered with bowel movement despite the abnormal position of the exteriorized loop.

CONCLUSION

Our experience is limited to fourteen cases, ten patients having had resections. Manifestly, leakage into the peritoneum from a questionable point in the bowel

cannot occur when that point is walled off outside the abdominal cavity. Our experience has also indicated that it is not dangerous to reposit an exteriorized loop even after it has been bathed in feces for days, if it is cleansed by thorough washing. This method is, of course, much more troublesome and often involves at least two operative procedures but it does eliminate peritonitis from leakage.

SUMMARY

A new method for diminishing peritonitis from leakage after perforation or resection

of exteriorizable bowel is presented. It is based on two propositions: (a) that peritonitis from leakage cannot occur if the leak (actual or potential) is walled off outside the peritoneal cavity, and (b) that it is safe to reposit bowel which has been exteriorized for several weeks after cleansing it with saline solution.

REFERENCE

1. Method for preventing or diminishing peritonitis from leakage after intestinal resection or perforation. *Proc. Soc. Exper. Biol. & Med.*, 45: 600-602, 1930.



If the paralysis (in poliomyelitis) is unilateral and localized, there is little or no respiratory distress, but inspection shows that the breathing is weakened on one side. If the paralysis is bilateral, the breathing is mainly diaphragmatic. The examiner should note alternate bulging and retraction of intercostal spaces.

PEPTIC ULCER, HYDROCHLORIC ACID AND EDKINS' THEORY

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LOGICAL discussion or rational treatment of peptic ulcer presupposes a familiarity with the following: (1) Normal gastrointestinal physiology; (2) signs and symptoms of abnormal function that justify diagnosis; (3) cause or causative factors, and (4) various types of treatment and indications for each.

Evaluation of various treatments presupposes a familiarity with the natural history of untreated disease and the distinctions between cure and relief of pain or spontaneous remissions.

Physiology of the stomach concerns motor and secretory functions. Tonicity, peristalsis, sphincter action and control of motor activity are complicated and space will not permit a discussion at this time.

Secretory action is probably more important in peptic ulcer. The secretion of the fundus and the antrum differ, the former being acid and the latter alkaline.

The stomach is, embryologically, a double organ; the fundus might be an evagination similar to such structures as the salivary gland, liver and pancreas but differs by not having a narrow duct to transmit secretions.

The practical physiologic problem concerns the three types of stimulation that may cause the fundus to secrete hydrochloric acid, viz., (1) Psychic—vagus, cerebral; (2) gastric—chemical, mechanical contact, tension, gastric hormone; (3) intestinal—amino acids, intestinal hormone. The proper synchronization of these stimuli, balanced by alkaline secreting mucosa, is followed by normal symptomless function; the opposite produces various symptoms.

Diagnosis is, of course, the keystone of treatment. Incorrect diagnosis leads to incorrect and unsatisfactory results. The

difference between gastric and duodenal ulcer (because of potential malignancy in the former) is not purely academic. The history of duodenal ulcer is usually quite characteristic, but with such occurrences as typical history with no ulcer (at operation or autopsy) and no history with proven ulcer, mistakes are not uncommon. The diagnosis should be reasonably accurate if it is the result of careful consideration of four factors, viz., the history, which is of most value; the physical examination, which may be of little value; the clinical and x-ray laboratory findings, which are definitely helpful.

The cause is unknown, but a common and constant finding is hydrochloric acid. With achlorhydria erosion and other types of ulceration may develop, but peptic ulcer does not occur. Causes of acute ulcerations are known, but why certain abrasions of gastric and duodenal mucosa become chronic and others do not, is still an enigma. Peptic ulcer may be considered as a result of an imbalance between a defensive (alkaline) and an aggressive (hydrochloric acid) factor. The cause of this imbalance is not known and it is probable that there are many causative factors.

The fundamental change might be circulatory, either mechanical that is, quantitative due to cardiac, vascular or nervous changes; or nutritional, that is, qualitative, due to metabolic, anemic, infective endocrine, vitamin or other changes. Such disturbances coupled with local neuromuscular instability might cause abnormal capillary permeability, with consequent interference with nutrition of the stomach wall. The subsequent digestive action of gastric juice creates the typical peptic ulcer. But such an explanation seems

inadequate, when excision with its circulatory disturbance, is followed by satisfactory result.

TREATMENT

Treatment of peptic ulcer is still an unsolved problem, despite many laboratory experiments and clinical experiences with a multitude of new and variously modified old treatments such as: ambulatory medical management and medical management with recumbency and hospitalization; surgical treatment of various types, after failure of medical managements, and more and more radical surgical treatment for so-called intractable ulcer.

These various types of treatment are all based upon the same fundamental objective, that of reducing gastric acidity.

	Nonoperative	Operative plus Nonoperative
After hydrochloric acid secretion	Diet: alkalis, antispasmodics, rapid emptying, aspiration, posture	Excision (local) Pyloroplastics Gastroenterostomy: rapid emptying, regurgitation
Before hydrochloric acid secretion	Diet: fats, salt poor, vitamins Medicine: atropine, bromides Antihormone: histaminase Antisecretagogues: endocrine, enterogastrone, urogastrone	Gastrectomy: distal (antrumectomy) (Edkin's Theory) Gastrectomy: partial: distal and middle (small area of acid secreting fundus) Gastrectomy: subtotal: distal, middle and proximal (larger area of acid secreting fundus) Gastrectomy: proximal (fundusectomy) (still larger area of acid secreting fundus with preservation of distal, alkaline secreting antrum and pyloric sphincter mechanism)

NONOPERATIVE TREATMENT

There seems to be an increasing tendency to recognize peptic ulcer as a general disease, with a local lesion, which may be multiple. In consequence there has been an increase in nonoperative treatments, so-called "medical management," based chiefly upon dietotherapy and neutralization which may be roughly divided into: Neutralization of hydrochloric acid *after* secretion (diet, alkalis, rapid emptying,

aspiration and antispasmodics), and reduction of secretion of hydrochloric acid (diet, fatty and salt free, antisecretagogues, histaminase, enterogastrone and urogastrone).

A practical antisecretagogue, when developed, will probably solve the question of nonoperative treatment.

OPERATIVE TREATMENT

The chief indications for surgery are complications such as, obstruction, perforation, hemorrhage, malignancy and intractability. Organic stricture is rare and with proper preoperative treatment stenosis will often be relieved. Perforation calls for immediate operation. Early operation in a second hemorrhage is being advocated, but a consensus of opinion has not been reached.

Cancer rarely develops in duodenal ulcer, but it is a strong argument in favor of excision of a gastric ulcer, as a prophylactic measure. Recurrent, or intractable ulcer, especially after previous gastroenterostomy, is a definite indication for surgical treatment.

A distinct trend is away from local excision, pyloroplastics, gastroenterostomy and distal gastrectomy, because of unsatisfactory results; and a contrasting trend is toward proximal gastrectomy, because of more favorable results.

Local resection or excision of the ulcer, of course, in itself does nothing to cure the disease or to remove or counteract the cause. At first it was considered radical, but later was found to be but a palliative measure and its use is now very limited. That resection or excision of the ulcer is not necessary to produce a satisfactory result is shown by the often prolonged improvement following various operations in which the ulcer remains.

Pyloroplastics act chiefly by altering motor function, and indirectly upon secretion by neutralization following reflux of duodenal contents into the stomach. Such operations have not been markedly successful and are being discarded.

Gastroenterostomy is becoming recognized as an unanatomic, unphysiologic procedure that is rarely indicated, except in organic pyloric obstruction. The frequent and increasing sequence of stomal or jejunal ulcer is rapidly discouraging the use of gastroenterostomy.

Distal gastrectomy for duodenal ulcer has been recommended for some years by certain European surgeons, notably Haberer, Finsterer and others, and by Richard Lewisohn in New York and Alfred Strauss in Chicago. Lahey,¹¹ of Boston, Miller, of Montreal, Reinhoff, of Baltimore, and many others rely more frequently upon distal gastrectomy in the surgical treatment of duodenal ulcer.

The Mayo Clinic's¹⁶ (1938) report shows that surgical treatment for duodenal ulcer is less frequent, and when operation is performed gastroenterostomy is employed less frequently and distal resection more often.

Distal gastrectomy, pyloro-antrumectomy, was based first upon Rodman's¹⁵ theory, i.e., removal of the "ulcer bearing area" which is, in reality, merely an enlarged local excision. This type of operation, at present, is based (consciously or subconsciously) upon Edkin's theory, "Gastric Hormone."⁷

This theory, presented in 1906, briefly stated that "The antral mucosa secretes a hormone (gastrin) that, when carried in the blood stream to the fundus of the stomach, stimulates the parietal cells to secrete hydrochloric acid."

Edkins thought that early gastric digestion might lead to the formation of substances which had particular influence in the development of certain gastric secretions. He noted that, "Extracts of *pyloric* mucous membrane contain an active substance when injected into blood vessels, which leads to secretion of gastric juice." (hydrochloric acid.) No study of duodenal mucous membrane was made. This theory is not new (1906) and has not as yet been accepted by either physiologists or clinicians.

Most physiologists consider the so-called

gastric hormone, gastrin, to be histamine or a histamine-like substance, an end product of protein digestion, or an amino acid that may be found in the duodenum as well as in the antrum. The similarity in structure of the antral glands and Brunner's glands of the duodenum, helps such a supposition. Their chief difference is in the location relative to the submucosa.

Experiments of various types and clinical reports by Smidt (quoted by Finsterer⁸) E. B. Lewis,¹² J. H. Grindley¹⁰ and O. H. Wangensteen¹⁷ do not confirm Edkins' theory. Even if this theory is correct, the influence of antral resection upon fundal secretion might not be noteworthy because of the remaining two types of gastric stimuli (psychic and intestinal).

Clinically, after removal of the pylorus and antrum and reestablishment of the gastrointestinal continuity by gastrojejunostomy, it is difficult to determine how much reduction in gastric acidity is due to neutralization by reflux of duodenojejunal secretion. Practically, distal gastrectomy has failed to reduce acidity satisfactorily and recurrences have gradually led to the additional removal of more and more of the proximal portion of the stomach with more and more of the acid secreting fundus.

Granting the correctness of Edkins' theory, and presuming the objective of treatment to be diminution of hydrochloric acid secretion, and accepting the three physiologic types of stimulating hydrochloric acid secretion, it would seem that removal of, or interference with part of the second stimulant, while the others remain active, would not greatly reduce the secretion of hydrochloric acid.

Certain distinct disadvantages may follow distal gastrectomy, the chief of which is removal of the pyloric sphincter which normally separates the acid stomach contents from the alkaline duodenal contents.

This complicated, delicately balanced and synchronized antropylo-ro-duodeno-neuro-muscular mechanism cannot be reestablished by any artificial gastrointestinal communication and its destruction

constitutes a serious mutilation. The normal duodenum is the source of many secretions and hormones (secretin, cholecystokinin, enterogastrone and perhaps others) with important physiologic functions, and the first step in their liberation is due to the arrival of acid gastric contents into the duodenum.

Another reason for retaining the distal stomach, when possible, is the suggestion of Meulengracht¹³ that the "intrinsic factor" of Castle, the anti anemic substance, may originate in the pyloric glands as well as in the duodenal Brunner's glands.

Physiologically and clinically, it would seem that removal of the antrum is not absolutely necessary in surgical attempts to reduce gastric acidity. Persistence of hyperacidity and recurrent peptic ulcer after removal of the antrum speak so strongly against the theory that the present trend is to be seen in the development of proximal gastrectomies, i.e., operations which remove more and more of the fundal acid secreting mucous membrane. This "*shift to the left*"¹¹ from alkaline to acid secreting portions of the stomach is well shown in the gradual evolution from antrumectomy (distal) through partial gastrectomy (distal and proximal) to subtotal gastrectomy (distal and more proximal).

Subtotal gastrectomy has improved results, but produced serious physiologic faults, viz., loss of sphincter action at gastrointestinal anastomosis and diminution of alkaline gastric secretion.

The next step in the surgical treatment of duodenal ulcer would seem to be proximal gastrectomy, with retention of the distal alkaline secreting portion of the stomach and of the pyloric sphincter. This procedure was suggested by the author in 1929.^{4,5} In 1940, Wangenstein¹⁷ published a "Preliminary description of subtotal excision of the acid secreting area for ulcer" and Zollinger¹⁸ emphasized removal of the fundus. In 1941, Friedell⁹ discussed this aspect of the subject.

Personal clinical experience with proximal gastrectomy, that is, partial fundusec-

tomy in conjunction with dietotherapy, have recently been published.^{2,3}

The total number of such cases is now twenty-five; the newer ones are too recent to justify a consideration of the remote results, but the first, an intractable case, with two previous perforations was operated upon in December 1931⁶ and despite many unfavorable factors, continues to be entirely free from gastric symptoms.

An attempt to evaluate the result of treatment is difficult. Before doing so, one must be familiar with the life history of *untreated* peptic ulcer which is characterized by sudden spontaneous remissions, often of many years duration. Cure of disease must be differentiated from relief of pain and from spontaneous remissions.

Knowledge of the fact that symptoms may exist without an ulcer being present and that ulcers, ready to bleed or to perforate, may produce no symptoms, should cause one to hesitate before considering a given case as cured.

For example, I was called by an associate to see the splendid eight year postoperative result of an operation for perforated peptic ulcer. In my interview with the patient he was asked about his symptoms *before* the perforation. In reply he stated that he had experienced no gastric symptoms before the severe pain that immediately preceded his operation and that he had had no symptoms since. In view of this history I asked why he might not have another perforation tonight. About three months later I again saw this patient in the hospital after an emergency operation for a second acute perforation.

On the other hand, one must remember that return of symptoms such as heme-temesis, melena or "indigestion" does not necessarily mean return of peptic ulcer, but may be due to the developing of other pathological condition, such as cirrhosis of the liver, gastritis or hemorrhoids.

Thirteen years ago I performed an exclusion operation for a large duodenal ulcer in which the chief symptom was

melenas. The patient was told that the ulcer remained and that he might have a recurrence and if so he was to return at once for further treatment. About one year later the patient presented himself much discouraged and reconciled to the idea of another operation. But rectal examination revealed a very large bleeding hemorrhoid. Proper treatment of this hemorrhoid has been followed by no bleeding and an entirely satisfactory result.

Indigestion, dyspepsia, gas, etc., may be due to a multitude of intra- or extra-peritoneal diseases other than a recurrent peptic ulcer.

Seemingly permanent cures, spontaneous remissions, after evidently inadequate medical management or theoretically insufficient surgical treatments, and on the other hand, recurrences after repeated theoretically competent surgical operations, make a proper evaluation of treatment difficult and statistics misleading.

CONCLUSIONS

1. Physiologically the stomach may be divided into an acid secreting fundus and an alkaline secreting antrum.
2. Hypersecretion of hydrochloric acid is a constant finding in peptic ulcer.
3. Secretion of hydrochloric acid is due to psychic, gastric and intestinal stimuli.
4. Treatment aims to reduce hyperacidity by neutralization after secretion, or by diminishing secretion.
5. Results after "medical management" in the uncomplicated cases of duodenal ulcer are quite satisfactory.
6. Complicated or intractable cases are usually treated by surgical measures, gastric resection.
7. Edkins' theory presumes that an antral hormone, gastrin, stimulates fundic acid secretion.
8. This theory is the basis for distal resection of the stomach in the treatment of duodenal ulcer.
9. This theory has not been proved either experimentally or clinically.

10. Unsatisfactory results after pylorotomy, antrumectomy and partial gastrectomy have resulted in attempts at improvement by the removal of more and more of the proximal acid secreting stomach, i.e., subtotal resection.

11. It is suggested that subtotal resection be modified by preservation of the alkaline secreting antrum and the pyloric neuromuscular sphincter mechanism.

12. Because of various unknown factors it is wise to refrain from drawing conclusions relative to results of treatments until after the elapse of at least five years.

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PRIMARY LIVER CELL CARCINOMA

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IN a survey of 2,870 surgical and post-mortem malignant tumors, we encountered only four cases of primary liver cell carcinoma. We deem it worthwhile to report these four cases.

CASE REPORTS

CASE I. Mrs. B. F., a thirty-four year old housewife, entered the hospital on July 12, 1937, complaining of sharp pain in the upper right quadrant.

Her history dates back to four weeks previous, when she experienced a similar attack which lasted several hours. At that time there was no nausea or vomiting and after several hours the pain subsided to a dull ache radiating to the right axillary and subscapular regions. Two weeks before admission she was nauseated and vomited several times. On July 10, the acute symptoms recurred and two days later she entered the hospital. During the present illness there had been marked anorexia, moderate diarrhea, and a weight loss of twelve pounds. There had never been any jaundice, chill, hematemesis, tarry or clay-colored stools. The family and past histories were essentially negative.

Physical examination revealed a fairly well developed and fairly well nourished negress who did not appear acutely ill. The temperature was 99.6°F., the pulse 84, respiration 20, and the blood pressure 110/80. There was an internal strabismus. The ears, nose and throat were essentially normal, and there were no palpable lymph-nodes. The lungs were clear and resonant with the right diaphragm somewhat elevated. The heart was normal. There was moderate tenderness and muscle spasm in the right upper quadrant of the abdomen, and beneath the right costal margin was felt a soft mass, 10 cm. in diameter, which was smooth, nonmovable and tender, and seemed to be attached to the liver. Neither the liver edge nor the spleen were felt. The remainder of the examination was normal.

The urine was normal. The hemoglobin was 90 per cent (Tallqvist): there were 4.40 million

red blood cells and 8,500 white blood cells with 70 per cent polymorphonuclears. The blood Wassermann and the spinal fluid Wassermann tests were negative. The icteric index was 7, and the Van den Bergh test negative. The blood sugar was 76 mg. per cent and the NPN 27 mg. per cent. The glucose tolerance test showed the fasting specimen to be 82 mg., and the subsequent half-hourly specimens 92.5, 135, 168, and 156 mg. per cent. A flat film of the abdomen and a chest film were normal. After the Graham test the gallbladder was not seen.

Her treatment consisted of elysis of 1,500 cc. of 2.5 per cent glucose in normal saline. One week later she was given fluids by mouth which were gradually increased to a soft diet. Two weeks after admission, she was given a 500 cc. blood transfusion. On August 3, an exploratory laparotomy was performed by Dr. E. Burke. His operative note states "Within the right lobe of the liver was a grapefruit-sized mass which pressed out against the anterior abdominal wall but was not adherent. Its wall, anteriorly consisted of a paper thin shell of hepatic tissue of extreme friability. Inadvertently, this thin covering was perforated which resulted in profuse hemorrhage. From the interior of the tumor, masses of pulpy material were discharged which looked exactly like bloody scrambled eggs." A biopsy was submitted to the laboratory and the pathological report was primary liver cell carcinoma.

Postoperatively, she reacted poorly and remained in a comatose state. She received intravenous glucose in amounts from 100 to 175 Gm. daily. Her temperature ranged from 99.6 to 101°F. The patient expired October 6, 1937. The total duration from the time of the first symptom was five months. Autopsy was not obtained.

CASE II. Mr. F. M., a sixty-six year old male complaining of dyspnea, was admitted to the hospital July 7, 1939, by request of a local physician with the diagnosis of hypertrophic cirrhosis. He had remained in good health until January when he noted shortness of

breath on exertion, followed by edema of the ankles, nocturia and a productive cough. Two weeks of rest in bed and medication, as

atrophic papillae. The heart was essentially normal and the blood pressures 144/68. The chest was hyperresonant except for slight dull-

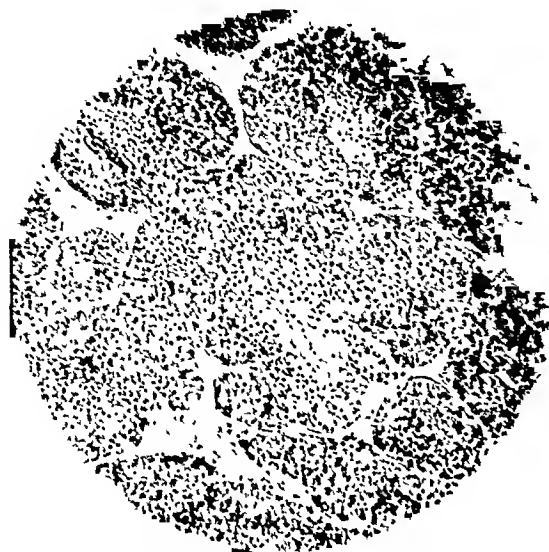


FIG. 1. Alveolar arrangement of the neoplastic cells. The stroma is scanty and avascular.

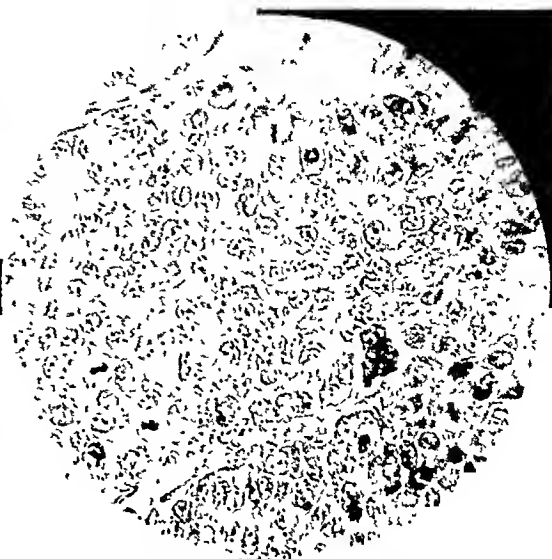


FIG. 2. Numerous mitotic figures of the neoplastic cells.

prescribed by his doctor, restored his health. About five weeks ago he began to notice he was quite constipated and had pain in the lower portion of the abdomen when his bowels did not move for several days. Occasionally, he had epigastric pain after meals, but he was never nauseated nor vomited. Three weeks before admission shortness of breath appeared and a productive cough, and three days before admission he noted sharp pain in the right side of the chest aggravated by breathing. The respiratory distress increased and his admission was advised. There had been a twenty pound weight loss during the previous five weeks.

The patient's mother had died at forty-six years of age with "consumption" and his father had died at forty-two years of age with the same disease. One sibling was living and well. His wife and one child were living and well. When seventeen years of age, the patient had typhoid fever, at twenty years he had a penile ulceration which was never treated, and at forty-five he had bronchitis.

On physical examination, the patient was an emaciated, white male who looked chronically ill, was in respiratory distress, and showed evidence of recent weight loss. There was moderate pitting edema of the ankles. His temperature was 101.4°F., pulse 90, and respiration 30. The nasal septum had a large clean perforation. The throat was diffusely injected and the tongue red and smooth with

ness in the right apex, with crackling râles and bronchovesicular breath sounds. The abdomen had prominent superficial veins. A firm, smooth, tender liver edge was felt at the iliac crest. The remainder of the examination was essentially negative.

The urine was normal. There were 70 per cent hemoglobin by Tallqvist, 3,820,000 red cells and 5,900 white cells per c. mm. with 69 per cent polymorphonuclear leucocytes. Blood sugar was 87 mg. per cent, and nonprotein nitrogen 36 mg. per cent. Icteric index was 7.4 and a Wassermann test was negative. Gastric analysis showed no free acid after a test meal and no occult blood present. A gastrointestinal series was essentially normal, except for displacement of the stomach and colon to the left by the large liver.

During his hospital stay, the temperature ranged from 98.6 to 100.6°F., epigastric pain remained fairly severe and the liver increased in size. He was given 50 cc. of 50 per cent glucose intravenously daily and 1 cc. of saturated solution of potassium iodide three times a day. However, he grew progressively weaker and on the twenty-sixth hospital day developed a chill. His temperature remained around 103°F. and he died on the twenty-ninth hospital day. The total duration of the disease from the onset of symptoms was eight months.

The relevant postmortem findings were as follows: Both lungs were studded with many metastatic nodules varying from 0.5 to 1.5 cm.

in size, which, on section, were yellowish brown and firm. The liver weighed 2,200 Gm. Its surface was reddish brown and nodular; an

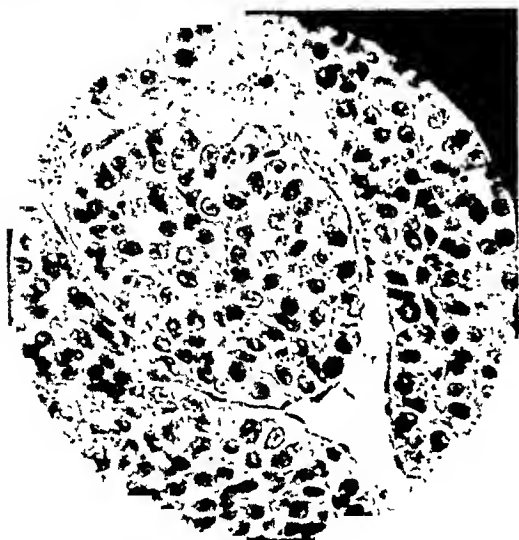


FIG. 3. Anastomosing sinusoids forming the supporting tissue of the neoplasm.

18 cm. soft nodule extended downward from the left lobe. The cut section revealed a poorly circumscribed mass occupying most of the right lobe, a similar mass filling the quadrate lobe, and a large mass in the left lobe continuous with the tumor projecting from its lower surface. Each of these masses was soft, friable, red, and some had yellowish necrotic centers. No neoplasm was demonstrable in the portal vessels. Microscopical diagnosis was primary liver cell carcinoma with pulmonary metastases.

CASE III. Mr. R. G., a fifty-six year old machinist, was admitted to the hospital on September 22, 1938, complaining of lower abdominal pain of three weeks duration. He had been in fairly good health until Labor day when he noted intermittent colicky pain lasting one to fifteen minutes which usually occurred after eating. His stools became small in caliber, and during the last two weeks he was markedly constipated. The lower part of the abdomen progressively increased in size, and during the past few days anorexia became quite marked, but there was no nausea or vomiting.

He had had the usual childhood diseases. In November, 1935, the patient was admitted to the Medical Center complaining of left upper quadrant pain; after observation for one week the pain subsided and he was discharged. In February, 1936, the patient was hospitalized again for removal of a ruptured appendix and

discharged thirty days later. In October, 1936, he was readmitted for intestinal obstruction and he was operated upon with the following findings: "There was an adhesive band completely constricting the lumen of the ileum, approximately 15 cm. from the ileocecal valve. The band extended from the mesentery of a loop and was attached to the serosa of an adjacent loop, causing a complete constriction of the intervening ileum. The terminal portion of the ileum was also tightly tied down, posteriorly by adhesions." Otherwise the abdominal cavity was free of pathological changes. On November 28, 1936, he was discharged from the hospital feeling well.

The family history was noncontributory. During the past five years he experienced infrequent precordial pain of two minutes duration, dyspnea on exertion and nocturia.

Physical examination revealed a fairly well developed and nourished white male, mentally alert and not acutely ill. The temperature was 98.8°F., pulse 88, respiration 20, and blood pressures 140/80. The right pupil was slightly larger than the left and irregular, but both reacted to light and accommodation. The sclerae were clear. The ears, nose and throat were essentially normal and there were no palpable lymph-nodes. The right diaphragm was slightly elevated, but otherwise the chest was clear and resonant. The heart was slightly enlarged to the left, the rhythm regular and sounds of poor quality without murmurs. The abdomen had well healed right rectus and midline suprapubic scars. The lower abdomen was distended and shifting dullness and a fluid wave were present. The liver edge was felt 6 cm. below the right costal margin, and it was firm, smooth and slightly tender. The spleen was not felt. A rectal examination was essentially negative and the extremities were normal except for marked varicosities of both lower legs.

The urine was normal. The hemoglobin was 80 per cent by Tallqvist, there were 4.82 million red blood cells and 12,000 white cells with 74 per cent polymorphonuclear leucocytes. The Wassermann test was negative. The blood sugar was 99 mg. per cent, and the nonprotein nitrogen 25 mg. per cent. The icteric index was 14, and the Van den Bergh test was negative. A chest film showed a small, well healed productive lesion in the right apex; a barium enema and a gastrointestinal series were essentially normal. Three weeks after admis-

sion there was no urinary sugar after a galactose tolerance test; the icteric index was 20 and the blood nonprotein nitrogen was 40.

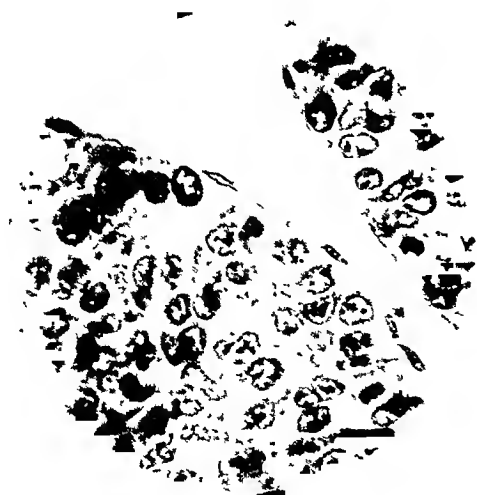


FIG. 4. Lining endothelium of the sinusoids.

The treatment was symptomatic. After several large enemas the bowels became regular and a soft diet was taken well. Paracentesis on the day following admission yielded only 20 cc. of a straw-colored fluid; on the twelfth day 1,700 cc., on the eighteenth day 1,300 cc., on the twenty-second day 2,000 cc., and on the forty-second day 1,900 cc. of straw-colored fluid. Medication consisted of brewer's yeast, sweetened drinks, 100 Gm. of intravenous glucose daily, and codeine phosphate for pain. The patient became steadily weaker, lost his appetite, started to vomit frequently on the fifty-third day, and on the fifty-fifth day he bled a little from the mouth and died shortly thereafter. The total duration of the disease from the onset of the first symptom was three months.

Permission was obtained for an autopsy limited to the abdomen. The liver weighed 2,500 Gm. Its surface was green and studded with numerous light, elevated, 1 to 2 cm. nodules. On section there were many discrete round, firm grayish, granular masses varying from 1 to 4 cm. in diameter which were evenly distributed throughout all lobes. The gallbladder, bile ducts, pancreas, and local lymph nodes, were grossly normal. Microscopical examination of the liver revealed primary liver cell carcinoma.

CASE IV. Mr. P. A., a seventy-seven year old white male, entered the hospital on May 29, 1939, complaining of abdominal pain of one month's duration. He had been in fairly good health until four weeks previous when he noted

a dull, persistent epigastric pain which radiated laterally into the left flank and persisted until admission. One week later his appetite became



FIG. 5. Cord-like arrangement of the neoplasm.

poor. There had been no nausea or vomiting, diarrhea or constipation, jaundice, bloody or clay colored stools.

The family history was essentially negative except that his wife died of pulmonary tuberculosis at thirty-five years of age. Fifty years ago he had gonorrhea and one year later a penile

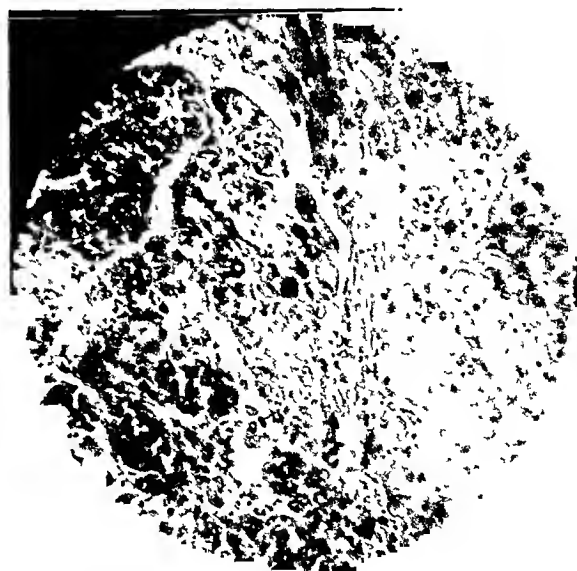


FIG. 6. Inconspicuous stroma separating the tumor from the parenchyma of the liver.

chancere which was never treated. During the past four years he had noted pain in the lower back and nocturia. During the past year there had been some loss of strength and an estimated weight loss of fifty pounds. He had never been a heavy drinker of alcohol.

Physical examination revealed a fairly well developed and nourished white male, mentally

alert and in no acute distress. The temperature was 98.8°F., pulse 88, respiration 20, and blood pressure 160, 80. The skin of the trunk, arms,

mass was located in the left lobe near the falciform ligament. Microscopical section of the tumor showed typical liver cell carcinoma.

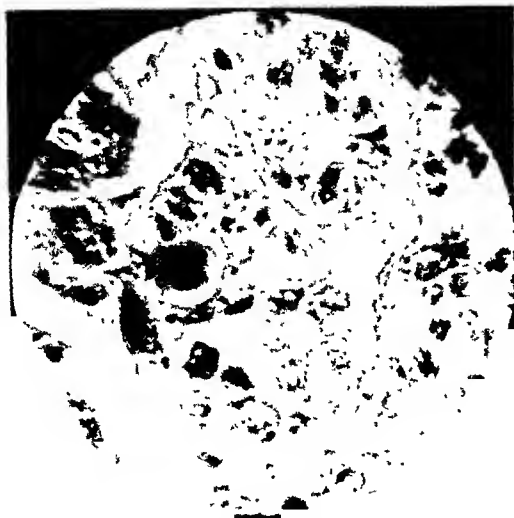


FIG. 7. Large mononuclear giant cells.



FIG. 8. Metastasis to the lung showing areas of emphysema.

and legs had scratch marks and a maculopapular eruption. There was a faint icterus of the sclerae. The ears, nose and throat were normal and there were no palpable lymph nodes. The chest was clear and resonant, and the heart was essentially normal. The abdomen was moderately distended. There was tenderness in the left upper quadrant and in the left costovertebral angle. In the epigastrium was a nontender, firm, fixed mass measuring about 6 cm. in diameter. The remainder of the examination was essentially normal.

The urine was essentially normal. The hemoglobin was 80 per cent by Tallqvist, the red cell count 4.27 million, and the white cell count 11,400 with 73 per cent polymorphonuclear leucocytes. The fasting blood sugar was 116 mg. per cent. A flat film of the abdomen was within normal limits.

After admission he rested quietly, although the abdominal pain continued. The following day he suddenly fell into coma, became cyanotic and the respirations became irregular. In spite of stimulants he died quietly on the third hospital day, one month after the onset of the first symptom.

Postmortem examination revealed two liters of slightly turbid, yellowish peritoneal fluid. The liver weighed 1,750 Gm. Its surface was brownish gray in color and presented numerous nodules. On cut section, there were many poorly encapsulated 3 to 10 cm. masses of soft, friable, red or yellowish tissue. The largest

Pathological Observations. Microscopically, each of the livers showed closely related alveoli (Fig. 1) separated by sinusoids. The cells were acidophilic, polygonal, with one or two nuclei which were frequently in a state of mitosis. (Fig. 2.) The sinusoids anastomose (Fig. 3) and are partially lined with a single layer of endothelial cells. (Fig. 4.) The cells in places have a cord-like arrangement, but the stroma is chiefly composed of capillaries. (Fig. 5.) A scanty amount of stroma separates the tumor from the liver parenchyma. (Fig. 6.) Occasionally large mononuclear giant cells are seen. (Fig. 7.) Within the lung the cellular characteristics are maintained and here the lobules are similarly separated by capillaries partially lined with a single layer of endothelium. (Fig. 8.)

CONCLUSIONS

1. Carcinoma of the liver still is a rare tumor. It represents 0.14 per cent of our malignancies.

2. The microscopical diagnosis in the vast majority of cases is not difficult.

3. The varieties of symptoms and absence of a palpable mass render the clinical diagnosis extremely difficult.

4. The duration of the disease in our series, once the symptoms manifest themselves, is five months.

ENDOMETRIOSIS OF SIGMOID AS A CAUSE OF ACUTE INTESTINAL OBSTRUCTION*

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INASMUCH as the bowel is occasionally seriously invaded by aberrant endometrial tissue and a characteristic syndrome is often produced thereby, it is advisable for the surgeon to be aware of the possibility and become familiar with the symptomatology.

Rokitansky is credited with the earliest description of adenomyoma of the uterus in 1860.¹⁷ A variety of extra-uterine endometriomas (adenomyomas) were described by Cullen,¹⁰ and he emphasized the frequent involvement of the rectum via the rectovaginal septum. Spencer,³⁷ in 1913, first described endometriosis of the sigmoid, and since that time isolated case reports^{3,5,10,26,27,30,35,38} and a few series^{8,20,23} of such cases have been published. A minor proportion of the cases have had obstructive symptoms.^{4,8,13,15,19,20,31} The preoperative diagnosis of endometriosis as the cause of acute obstruction of the sigmoid is rarely made.

PATHOLOGY

A localized area of endometrium-like tissue bearing characteristic glands, stroma and, occasionally, smooth muscle, and thriving in an unnatural site is an endometrioma, according to Blair-Bell;⁶ diffuse or multiple areas constitute endometriosis; however, the terms are loosely interchanged. The cyclic and progressive recurrence of a clinical syndrome induced by the physiologic, menstrual-like changes occurring in this aberrant and invasive, but almost universally benign tissue provides the chief diagnostic features of the disease. Thomson³⁹ reported malignant degenera-

tion of the muscle elements of a rectovaginal "adenomyoma" with fatal pulmonary metastases. No report of the development of cancer in an endometrioma of the sigmoid has been found. In the sigmoid, involvement of the serosal and muscular layers is usual, and atrophy of the mucosa without invasion by the underlying endometrial tissue is commonly found. Any degree of stricture may be produced, and the endometrioma may project into the lumen as a polyp; intussusception may be produced thereby. Characteristically, the serosa is puckered over the lesion and the gross appearance by inspection and palpation is almost indistinguishable from carcinoma. No mesenteric lymphadenopathy is associated with endometriomas, however.

Though many theories have been propounded to explain the origin of endometriosis, two or three are now generally debated. Sampson's^{33,34} attractive theory proposes that endometrium, shed from the uterine canal at the time of the menstrual period, is forced in retrograde direction through the fimbria of the Fallopian tube and becomes implanted on the peritoneum, usually where there is a fold or niche in the serosa. Another theory, that Muellerian or Wolffian cell rests are stimulated to proliferation in adult life, is less commonly accepted now. A third, and popular theory²⁹ concerns an inflammatory irritation of pluripotential serosal cells provoking metaplasia or dedifferentiation to endometrium-like tissue. Allen² has experimental evidence suggesting that such cells may be stimulated by glandular dysfunction.

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INCIDENCE

Endometriosis of the various reproductive organs is now recognized as a relatively common disease. In 1,000 gynecological surgical cases Green-Armytage¹⁵ found endometriosis in 8.9 per cent. Cullen¹⁰ noted involvement of the rectovaginal septum frequently, but the incidence was lower in Masson's series.²³ With decreasing frequency (and decreasing proximity to the uterus) are found endometriomas of the sigmoid, abdominal wall and umbilicus, ileum and appendix. The bladder and vaginal wall are involved in a similarly small percentage of cases. In a series of 576 patients with 689 organs involved, Masson found fourteen cases (2.4 per cent) with involvement of the sigmoid, while similar involvement was found in four (or 3.8 per cent) of 104 cases of endometriosis at the Lahey Clinic by Cattell.⁸ Varying degrees of obstruction are reported, but acute obstruction due to sigmoidal endometriosis is apparently uncommon.

DIAGNOSIS

The symptoms of endometriosis of the sigmoid were extensively reviewed by Mayo and Miller;²⁴ they vary little from the syndrome of pelvic endometriosis.^{16,28} The disease occurs only in the female and generally in an otherwise healthy woman in the years of active menstruation, although a few cases are recognized after the climacteric.^{2,25} Progressive acquired dysmenorrhea is almost constant. Many have menstrual irregularities, metrorrhagia and menorrhagia. Dyspareunia and sterility are frequent complaints. Pain on defecation or examination of the rectum is common, and there is often comenstrual constipation with a low incidence of occult or gross blood in the stools. The sigmoidoscopic examination may be limited by pain or abrupt angulation of the bowel, and, though an extrinsic mass may be suspected, there is rarely a detectable mucosal lesion. A barium enema may reveal a filling defect with normal mucosal pattern,^{11,19} as in our case. Accentuation of the presenting symp-

toms at the time of the menses is the constant diagnostic feature.

Physical examination often reveals tender tubo-ovarian masses, cysts, rectovaginal nodules, or other evidence of pelvic endometriosis. Abdominal palpation is usually disappointing. Glandular hyperplasia of Swiss cheese type is commonly found by uterine curettage,² and a high incidence of fibroids has been noted.^{2,32}

TREATMENT

In most cases, endometrioma of the sigmoid is found incidentally during a laparotomy for pelvic endometriosis with which it is so commonly associated. Should the degree of pelvic involvement indicate removal of the ovaries (and the body of the uterus, in the opinion of most writers), subsidence of the sigmoid lesion may be expected if the involvement is not too extensive. Small discrete endometriomas of the bowel may be eradicated by cautery or resected when oophorectomy is not contemplated, and the bowel wall may be sutured transversely to prevent stricture as suggested by Maclean.²²

Large endometriomas of the sigmoid, especially those producing obstruction by narrowing or intussusception, may require resection and end-to-end anastomosis, more properly performed after diversion of the fecal stream by colostomy. The majority of cases reported have been treated in a manner similar to this.

However, we have noted several reports of recession of large sigmoidal endometriomas following castration alone, or colostomy and castration in obstructed cases. Cattell reported one case of rectovaginal and sigmoidal endometriosis in which, sixteen months after castration, the sigmoid showed no lesion by x-ray. Hutchins,¹⁸ Eggers,¹² Miles,²⁶ Stetson and Moran,³⁸ McKittrick,²⁵ Pemberton³² and others have had cases with severe sigmoidal involvement which appeared to regress with castration. We have found no report of subsequent laparotomy or necropsy on any patient who had an obstructing sigmoidal

endometrioma treated by castration alone. Pathological study of such a case would be of major interest.

Irradiation castration has some proponents.^{1,21,22} Opponents^{10,36} of this therapy conclude that: (1) total and permanent castration is not certain, (2) irradiation may activate a dormant pelvic inflammation, (3) simple and endometrial ovarian cysts are commonly associated with endometriosis of the pelvis or bowel and require surgical removal, and (4) because carcinoma can be definitely excluded only by microscopic examination in many cases, exposure for biopsy must be considered advisable.

Preservation of ovarian function, when possible, in women of childbearing age, by resection of all involved tissue without castration is advised. At the Mayo Clinic,⁹ of five patients with endometriosis who had multiple, thin, ovarian transplants in the abdominal wall after castration, four had no ensuing symptoms of ovarian insufficiency nor of the original disease.

CASE HISTORY

L. M., a housewife, age forty-two, entered Springfield Hospital July 5, 1940, complaining of obstipation of six days' duration and vomiting which began on the day of admission. Her last bowel movement was pencil-like and without blood occurring at the termination of a three day menstrual period characterized by profuse flow and more than usual cramping.

Four years before entry she was treated for incomplete abortion of a two months' conception. At that time she remarked intermittent, but not recent attacks of right upper quadrant pain radiating to the back, unaccompanied by jaundice and relieved only by opiates. The symptoms subsided, and the patient lost twenty-five pounds following dietary regulation.

Six months before the present admission she re-entered because of left-sided and upper abdominal pain of two months' duration. Sigmoidoscopic examination was limited by pain but no abnormality was detected in the distal 15 cm. Subsequent fluoroscopic visualization of barium enema, repeated once, was reported, "localized spasm of sigmoid as commonly seen after sigmoidoscopy." Three of four

stool examinations (general diet) were positive by benzidine test. Cholecystograms revealed poor function and numerous negative shadows



FIG. 1. Air contrast enema demonstrating filling defect in high sigmoid with preservation of mucosal pattern suggesting extrinsic involvement.

suggesting calculi. Cholecystectomy was performed January 8, 1940; the gallbladder contained about fifty mixed pigment and cholesterol stones; in routine exploration no abnormality of bowel or pelvis was recognized.

The patient's menstrual periods began at the age of thirteen occurring regularly every twenty-eight days and lasting five or six days with minimal headache and fleeting pelvic distress until about two months before the present admission when cramps became more severe, but never incapacitating, and the flow became more profuse with occasional clots. During a similar interval mild comenstrual constipation without bleeding was noted. The period immediately prior to the onset of obstruction was the most severe she had experienced.

She was first married at the age of twenty-five; one pregnancy resulted with a living child. Her second marriage took place at the age of twenty-nine; one pregnancy occurred, aborting at two months (v.s.). Deep dyspareunia was present without bleeding for ten years prior to admission.

Physical examination revealed temperature 100.4°F., pulse 90, respirations 50. She was a well nourished, restless female with flushed

face and grunting respirations; skin not dry; tongue coated but moist; chest resonant; breath sounds clear; diaphragms raised. The

bowel and distended colon. A loop of sigmoid colon was fixed to the left uterine adnexae by a 5 cm. mass involving both structures and



FIG. 2. Longitudinal section of excised portion of sigmoid showing puckering of serosa and intraluminal protrusion of endometrioma without ulceration. Mucosal surface is uppermost in photograph.



FIG. 3. Typical glands and stroma of endometrium-like tissue involving muscularis of sigmoid. $\times 70$.

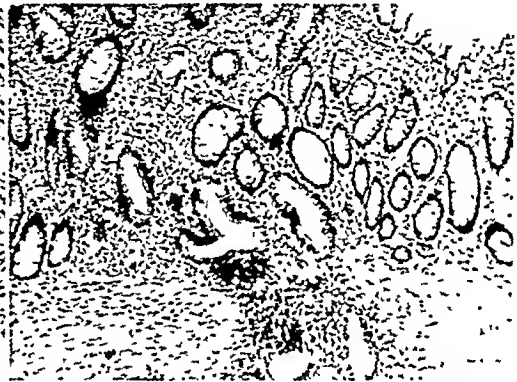


FIG. 4. Endometriosis invading mucosa from muscularis of sigmoid. $\times 70$.

heart was not enlarged; sounds were rapid and regular with soft, apical, systolic murmur; abdomen was moderately distended; doughy, full bowel in left abdomen; cecum and transverse colon areas tympanitic; peristaltic sounds infrequent, not crescendo nor tinkling. Extremities were not edematous; tendon reflexes were active. The cervix was scarred by old laceration, slightly eroded, retrocessed, pointing posteriorly; distention prevented palpation of the fundus but the entire uterus felt fixed by rigid broad ligaments, manipulation of which caused pain; firm, tender, nonfluctuant cul-de-sac; rectum was empty. *Admission diagnosis:* Intestinal obstruction due to endometriosis of bowel or adhesions from recent cholecystectomy.

Continuous gastroduodenal suction and intravenous fluids prepared the patient for operation twenty-four hours after admission. The abdomen was opened through the upper right rectus scar encountering collapsed small

producing obstruction. Accordingly, a loop of right transverse colon was exteriorized for colostomy and a catheter was inserted. Three days later the colostomy was opened and continued to function well. She left the hospital on the twenty-third postoperative day and returned two weeks later for roentgen examination which revealed a filling defect in the upper sigmoid colon suggesting extrinsic involvement. (Fig. 1.)

On September 2, 1940, the patient had gained eighteen pounds since the colostomy was formed, and she was re-admitted with the diagnosis of endometriosis of the sigmoid colon. The abdomen was opened through a left rectus incision. All small intestinal loops were inter-adherent by organizing adhesions resulting from the episode of obstruction. The right ovary was replaced by a 4 by 5 by 5 cm. unilocular cyst containing clear fluid. The cul-de-sac was smooth. Adherent to the posterior

surface of the left tube and broad ligament near the uterus was a loop of high sigmoid colon which was densely fixed to these structures by a 3 by 4 by 4 cm. mass infiltrating the antimesenteric half of the bowel wall. No mesenteric adenopathy was detected. Bilateral salpingo-oophorectomy, resection of the involved bowel and end-to-end anastomosis were performed. The colostomy spur was crushed in the usual manner during the convalescence and the patient was discharged on the twentieth post-operative day having had painless anal defecation. Readmission was necessary for further crushing of the spur and closure of the colostomy.

Pathological Report. Gross: (Fig. 2.) A 15 cm. section of slightly edematous sigmoid colon which presented, at the midpoint of the antimesenteric surface, a circular depression 6 mm. wide, 10 mm. deep and surrounded by grayish-red adhesions on the serosa. Here the lumen of the bowel admitted only a 5 mm. probe. At this point section revealed an elliptical, longitudinally situated, 25 by 8 to 15 mm. area overlying the serosal depression and characterized by atrophic mucosa from which arose two minute reddish cysts. The wall of this portion of the bowel was quite firm and 10 to 15 mm. thick, the serosa being separated from the muscularis by dense, grayish tissue deposited in radial, palisade arrangement and not grossly infiltrating the muscularis.

Microscopic: In the subserosa, muscularis and submucosa were numerous straight and convoluted gland spaces surrounded by connective tissue stroma of varying abundance. (Fig. 3.) No smooth muscle fibers were noted. The entire arrangement bore striking resemblance to endometrium, and no evidence of malignancy was detected. However, there was infiltration of the muscularis and, to a lesser degree, between the glands of the intestinal mucosa in scattered areas. (Fig. 4.) The wall of the left tube showed infiltration of similar endometrium-like tissue at the periphery.

Pathological diagnosis: Endometriosis of sigmoid colon and left Fallopian tube; hemorrhagic corpus luteum and simple follicular cyst of right ovary; Wolffian duct remnants in walls of both tubes.

COMMENT

This patient's symptoms and physical findings were sufficiently characteristic that

the diagnosis of endometriosis might have been made six months earlier. The longstanding history of dyspareunia and more recent sterility suggest that the disease had been present several years. The tumor of the sigmoid was surely present at the time of cholecystectomy though undetected. Characteristic features of this case leading to the proper diagnosis were: age, recent sterility, longstanding dyspareunia, novel dysmenorrhea and menorrhagia, constipation and rectal pain, left lower abdominal pains, lack of weight loss, painful pelvic and rectal examinations, and suggestive roentgenograms. We cannot form a definite opinion regarding the pathogenesis but believe that the sigmoid was invaded secondarily by endometriosis of the tube. Evidence of invasion of the mucosa as demonstrated by microscopic section in this case is contrary to the usual reports.

SUMMARY

Endometriosis of the bowel is of sufficiently frequent occurrence to warrant emphasis of the characteristic symptoms by review of a case in which the correct preoperative diagnosis was made, but only after acute obstruction had supervened.

Publication of detailed clinical and pathological follow-up examinations is advisable to ascertain more accurately the fate of endometriomas of the bowel which have been treated by castration without resection.*

Appreciation is accorded Dr. A. Vass, Pathologist of the Springfield Hospital, for preparation of illustrations.

* Since this paper was submitted for publication, an unmarried woman of thirty years was admitted to St. John's Hospital May 11, 1941, for treatment of dysmenorrhea and constipation. At operation a large chocolate cyst of the left ovary, rectovaginal and uterine endometriosis, and an almost completely obstructing endometrioma of the midsigmoid colon were treated by bilateral salpingo-oophorectomy, supravaginal hysterectomy and obstructive resection of the sigmoid. Distinct invasion of the mucosa was demonstrated grossly and microscopically. Complete situs inversus was an incidental finding.

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A TECHNIC FOR THE SATISFACTORY USE OF THE MILLER-ABBOTT TUBE*

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THE Miller-Abbott tube offers an ideal physiological type of temporary treatment for intestinal obstruction. But the advantage of this therapy may be entirely lost through ineffective functioning of the tube, due to errors in management of the apparatus. It is the purpose of this paper, therefore, to record the details of an effective method for using the Miller-Abbott tube.

HISTORICAL COMMENT

The concept of treating obstruction by small intestinal drainage is not new. It was suggested in this country by Oden¹ in 1923 and advocated by Matas² in 1924. Wangenstein and Paine³ improved and popularized this type of treatment by their introduction of duodenal suction in 1933. Recently, this form of therapy has been carried to its logical end by Abbott and Johnston⁴ with a method of suction applied just proximal to the point of obstruction within the bowel. In order to accomplish this, a long suction tube is passed through the stomach and small bowel. Peristalsis acting upon an inflatable balloon near the tip of the tube carries it along the intestinal tract. This special apparatus was devised in 1934 by Miller and Abbott.⁵ Favorable reports on its use in intestinal obstruction have been published by Abbott,^{4,6} Johnston^{4,7} and Leigh.⁸

DESCRIPTION OF THE TUBE

The Miller-Abbott tube† is made of medium soft rubber. It has a total length of about nine feet and a circumference of 16

mm. Smaller sizes are available. An eccentric longitudinal septum within the tube forms two unequal lumina. The smaller lumen leads into a latex balloon which surrounds the tube near the lower end. The larger lumen leads to a small duodenal bucket at the tip of the tube. There are several perforations through the wall of the tubing into the larger lumen just proximal to the balloon. Beginning at the suction tip the tube is marked off at 45, 60 and 75 cm. Sixty cm. is the usual distance from the nares to the pylorus. From the 60 cm. mark the tube is marked off in feet. Accordingly, the distance that the tip of the tube has progressed beyond the pylorus is indicated by the markings on the tube at the nose. The proximal end of the tube is fitted with double, metal suction tips leading to the separate lumina. (Fig. 1.)

INDICATIONS

Broadly, the indications for employing small intestinal suction are the same as those for the use of duodenal suction. Specifically, this type of therapy is indicated (a) for preoperative decompression when there is no evidence of vascular occlusion, (b) in the management of postoperative mechanical obstruction resulting from fibrinous exudate and (c) in the treatment of obstruction due to paralytic ileus.

The Miller-Abbott tube is effective in both paralytic and mechanical obstruction.^{4,5} Small intestinal suction in the presence of obstruction represents a closer approach to normal physiological conditions than does duodenal suction. Abbott and Johnston have shown that the Miller-Abbott tube produces clinical improvement

† Supplied by the George P. Pilling & Son Company, Philadelphia, Pennsylvania.

* From the Surgical Clinic of the Peter Bent Brigham Hospital, Boston, Massachusetts.

when duodenal suction failed.¹ Accordingly, although this therapy is indicated in the same conditions as duodenal suction, its

course of intubation the rubber loses its elasticity, becomes discolored and acquires an unpleasant odor. Half of an ordinary

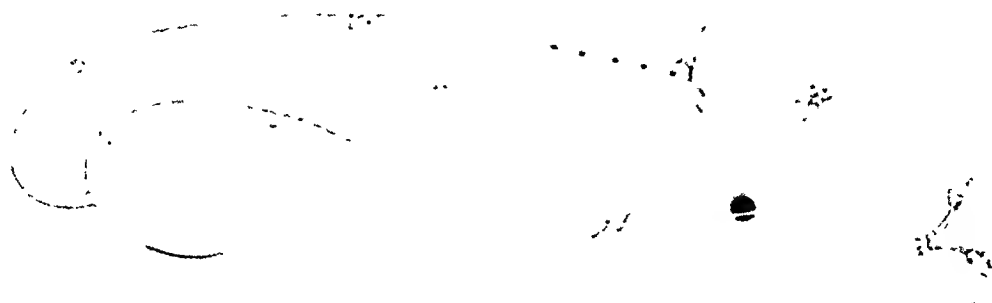


FIG. 1. Diagram of the double lumen Miller-Abbott tube.

choice is desirable as a more physiological and effective agent. We have used small intestinal suction in all types of obstruction that did not present evidence of strangulation.

CONTRAINDICATIONS

The possibility of strangulation or gangrene in the obstructed loop of bowel is a contraindication to small intestinal suction as well as to duodenal suction.² The reason is that in cases in which the intestinal vascular supply has been compromised, immediate operation should be performed to prevent a free perforation or a degree of gangrene which would make resection necessary. The use of the Miller-Abbott tube tends to minimize the symptoms and signs of strangulation and thus to diminish the urgency of operation, without improving the local situation. The presence of strangulation may be judged either on the clinical signs of elevated pulse, leucocytosis, rapid respirations, and fever, or on the presumptive basis that the particular type of lesion at hand may be especially prone to strangulation, as, for example, incarcerated hernia. If strangulation appears to be a reasonable clinical possibility, this therapy should not be elected except as preparation for immediate operation.

PREPARATION AND CARE OF THE TUBE

Each time the tube is used it is necessary to affix a new latex balloon because in the

condom is used to replace the balloon. The rounded end is perforated and it is whipped onto the tube with thread. (Fig. 2A.) The thread must not be so tightly wound as to occlude either lumen by pressure. As the balloon is tied on, enough slack in the latex must be left between the proximal and distal threads so that when the balloon is inflated the overall length is greater than the length of the tube included within the balloon between the ties. In this manner, as the balloon is inflated, longitudinal tension will be applied to the small segment of tube passing through the balloon, and this portion of the tube will not bend. (Fig. 2.) If this precaution is not taken, as the bag is inflated a longitudinal compression is exerted on the segment of tube within the balloon which produces a flexion in that portion that might hinder proper passage of the tube along the intestinal tract. (Fig. 3.) It is important to test the balloon against leaks as intestinal intubation cannot be accomplished if the bag is not inflated.

After the tube has been used, the balloon and its ties should be removed to prevent the production of a permanent constriction in the rubber tubing at the points where the thread is wound about it. Since the rubber tubing may retain a somewhat unpleasant odor, even after thorough soap and water cleansing, it has been our practice to soak it in cologne or lavender water if it is to be used soon again. Holes

through the wall of the tube, which must be made without perforating the septum, may be drilled with a round dental burr of

be immediately aspirated, giving assurance that the tip has reached the stomach. *The tube is passed to a point where the end is*

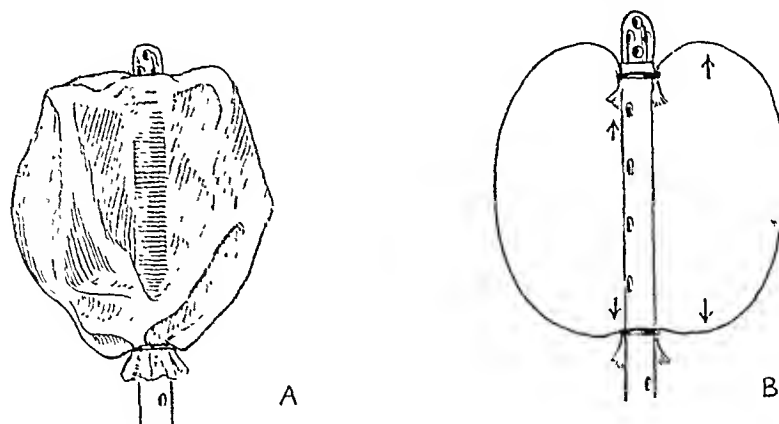


FIG. 2. A, proper method of attaching balloon, with enough slack in the rubber between ties to prevent bending of tip of the tube. B, inflation of properly attached bag produces longitudinal tension (see arrows) which keeps the included segment of tube straight.

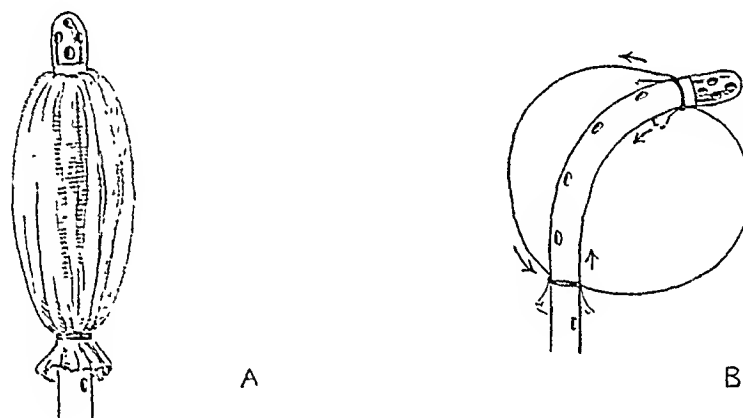


FIG. 3. A, improper method of attaching bag with too little slack in rubber between ties. B, inflation of bag produces longitudinal compression (see arrows) which bends the included segment of the tube, possibly making passage of tube difficult.

appropriate size. Drilling is facilitated by cooling the tube.

INTRODUCTION OF THE TUBE

Under most circumstances it is not difficult to pass the tube through the nose and into the stomach. Before the tube is passed a measurement should be taken to determine roughly how far the tube must be passed through the nose to make the tip approach the pylorus. With the bag fully deflated and lubricated with mineral oil, the tube is started through the nose which may be cocaineized. If the patient is cooperative, the end is passed into the stomach with a few swallows of water which can

about four inches short of the estimated distance to the pylorus. It is then tied at the nares with a cloth tape anchored to the nose and lip by adhesive. The use of the tape to hold the tube prevents adhesive material from sticking to its rubber walls and facilitates freeing the tube for further introduction.

The most important and difficult procedure is to accomplish the passage of the tip of the tube through the pylorus. The special value of the therapy depends upon the success of this step. We have had more satisfactory results by applying suction to the stomach for several hours before attempting to pass the tip of the tube into the duodenum. The

theoretical basis for this procedure is that when the dilatation is relieved, the stomach may be better able to regain its muscular tone and peristalsis which carries the tube through the pylorus. It is important to have the patient lie upon his right side to direct the end of the tube toward the antrum.⁵ Sips of clear fluid are allowed by mouth. After four hours about one inch of the tube is introduced through the nose every half hour until one more foot of tubing has been passed into the stomach. This step is designed to permit the tip to approach the pylorus slowly and to be carried into the duodenum, and not to allow the tube to coil in the stomach as a result of many inches of tubing being introduced at once. Coiling of the gastric segment of the tube resulting from too rapid introduction has been repeatedly demonstrated fluoroscopically.

After the foot of tube has been introduced slowly, an x-ray check should be made to determine whether the tip has entered the duodenum. If this has not occurred, there is little advantage in continuing the introduction since the tubing merely continues to coil in the stomach. In our experience, once the tube has become coiled in the stomach the tip has never been demonstrated to have passed the pylorus, and there is definite danger of the formation of a figure eight or overhand knot in the coiled tubing. Failure to recognize that the tube is not passing into the duodenum results in a delay of small intestinal intubation which may be a serious threat to the patient's welfare.

Clinical estimation of duodenal intubation is not reliable. Two presumptive signs that the tip had passed the pylorus were considered. The first was that if there is a definite change in the character of the aspirated fluid from a hazy white, mucoid material to a clear, bile-stained fluid, it may be assumed with some certainty that the tip of the tube has passed into the duodenum. This distinct change may be of real significance. However, in intestinal obstruction we have not found this sign to be

a very consistent one because of the frequent incidence of regurgitation of the duodenal contents into the stomach. The first fluid aspirated from the stomach often had a duodenal character and no change was observed as the tube passed into the duodenum. Because of the character of the aspirated fluid, we have occasionally assumed that the tube was passing along the small bowel when it was in reality coiling in the stomach and giving little effect. Case v, a fatality, is an example of this fallacy. The second was that rhythmic water manometric changes in bulb pressure, which may be taken from the tube leading to the inflated bulb, may be indications of duodenal peristaltic waves passing over the bulb. Certain pressure changes have been observed in balloons that were still in the stomach and could not be differentiated from the pressure variations after the bulb had definitely passed through the pylorus. It may be that we have not yet learned to evaluate these readings properly, but we have little real confidence in the non-radiographic indications of small bowel intubation.

It appears, therefore, that *the only certain way of determining the position of the end of the tube is radiography*, either by fluoroscopy or plain film. If the patient is too ill to be moved to an x-ray department, portable fluoroscopy or films at the bedside are satisfactory. Most of our therapeutic failures of Miller-Abbott suction occurred as a result of unrecognized failure of the tip to pass through the pylorus because no early roentgen check was made, since it was assumed on other evidence that suction was being applied within the small bowel.

If the tube is found not to have passed the pylorus on the first attempt, it should be withdrawn so that it is in its original position in the antrum of the stomach, and the above procedure repeated. If these measures are unsuccessful in producing duodenal intubation, it is usually possible to manipulate the tip through the pylorus under fluoroscopic control. We have preferred to withhold this method until at

least two attempts at passage have been made, feeling that manipulation under the fluoroscope is fatiguing and painful to the sick distended patient.

The greatest difficulty in passing the tube has been encountered in the toxic patients with peritonitis. All manipulations are especially hard because of the uncooperative state. The stomach itself seems to be of little assistance in propelling the tip through the pylorus. Therefore, the *early decision to employ the tube at the first sign of ileus before toxic conditions arise may be a life-saving precaution.*

Miller and Abbott⁵ have suggested an alternate technic of duodenal intubation. The stomach is emptied of all gas and is moderately filled with fluid. Air is introduced into the balloon. The patient is turned on his *left* side, and thus an effort is made to "float" the tip through the pylorus in contradistinction to the above described method of "sinking" it through the pylorus. We have had little experience with this procedure.

When it has been determined that the tip of the tube is well in the duodenum, the bag is inflated with 30 cc. of air. Too early or too great dilatation of the balloon at this point results in regurgitation of the tube. In Case xiv, the tip was placed into the duodenum by fluoroscopic control four times. Each time the bag was inflated with 60 cc. of air and each time the whole tube was immediately regurgitated. After the bag is properly inflated, it has been reported⁵ that the tube may be carried along the jejunum at a rate of approximately two feet an hour. One foot an hour is accepted as a reasonable clinical expectation. In our cases the tube has been introduced through the nose at a rate of six inches every half hour. This is accomplished by lubricating six or eight inches of the tube at the nose, which is passed as the patient takes several swallows of water. The tube is introduced in this manner until it has passed to its full length, or until the tip is demonstrated by x-ray to have reached either the obstruction or the ileocecal junction. Wangenstein

suction through collecting bottles is maintained while the tube is passing along the small intestine. The most rapid passage of the tube to the cecum was observed in a period of eighteen hours. In peritonitis it may be a matter of days. The progress of the tube can be halted at any time by deflating the balloon. The tubing should not be allowed to coil in the stomach as loops may prolapse into the duodenum and obstruct free suction by kinking the tube.

It is well to make an occasional check to be sure that the balloon is not leaking. This may be done by measuring in a syringe the amount of air that can be withdrawn from the balloon after it has been inflated for several hours. A diminution in the volume aspirated compared with the measured amount used to inflate the bag indicates the amount of leakage. To prevent clogging of the suction lumen or perforations, it has been our practice to irrigate it with 30 to 50 cc. of tap water every hour. In two cases irrigation of the suction lumen was not carried out, and in these there was unsatisfactory function of the tube because of obstruction in the lumen itself. The openings into the separate lumina at the proximal end of the tube should be clearly marked to avoid confusing them.

GENERAL CARE OF THE PATIENT

The presence of the tube offers no impediment to ordinary intake of food and liquids. In mechanical obstruction, when the tube has satisfactorily passed the pylorus, we have given clear fluids by mouth and, after about twelve hours of passage of the tube along the small bowel, soft solids were allowed. The rationale⁴ for this departure is that with the return of normal intestinal flow, the function of nutrition can be re-established by the bowel proximal to the end of the tube; this is a great advantage to the patient. In two instances, after the tube had passed to the lower ileum, house diets were given without untoward effects on the function of the apparatus.

To promote comfort and prevent crusting of the nasal mucous membranes, several drops of albolene should be run into the nose along the tube every four hours. With this care tubes are well tolerated by most patients. Fifteen days is the longest interval that a tube remained in place in our cases.

During the period of suction accurate daily records of fluid intake by mouth and by parenteral routes should be kept along with the total suction and urinary output. In this way the water balance can be followed accurately. Perhaps the most significant single index of water metabolism is Collier and Maddocks,⁹ criterion of the total daily urinary output. A daily output of 1,000 to 1,500 cc. of urine is considered satisfactory in the absence of cardiac or renal damage. Attention should also be directed toward the electrolyte, vitamin and protein metabolism. Protein, sodium chloride, carbon dioxide combining power, and hematocrit values of the blood are important in following the patient. None of our cases were observed to pass into acidosis which was considered as a possibility because of the constant removal of the alkaline intestinal fluids.

REMOVAL OF THE TUBE

Contrary to expectation, the tube may be easily removed, even when it has descended as far as the large bowel. The balloon is deflated and a foot or two is withdrawn each hour. This is accomplished without discomfort to the patient. We have chosen to be conservative about removing the tube because of the difficulty in replacing it. The indication for removal is the passage of fecal material and gas by rectum which demonstrates that the obstruction no longer exists. Before the tube is removed, suction should be discontinued for a long enough period to prove that the gastrointestinal tract can tolerate fluid and food by mouth without further signs of obstruction.

ADVANTAGES OF SMALL INTESTINAL SUCTION

The advantages of the Miller-Abbott therapy in intestinal obstruction may be stated as (1) control of distention, (2) physiological relief of obstruction, (3) avoidance of operative drainage of the bowel, and (4) control of postoperative distention and pressure on the suture line by continued suction after operation.

As the tip of the suction tube is propelled along the coils of gut by peristalsis, decompression is progressively accomplished by aspiration of fluid and gas from the distended loops of intestine as they are encountered. Decompression alone produces three beneficial results: The reduction of intra-intestinal pressure allows the return of adequate circulation to the bowel wall; reduced intra-abdominal pressure permits proper flow of blood in the great portal and abdominal venous channels;¹⁰ and, as there is more room for diaphragmatic excursion, there is better pulmonary aeration which reduces the possibility of pulmonary complications and facilitates the return of venous blood by the pumping action of the thoracic cage.

Physiological relief of the obstruction is accomplished by the Miller-Abbott tube in that an outlet for the intestinal contents is provided at a point just proximal to the obstruction. In this manner the normal intestinal flow may be resumed. The normal functions of the proximal portion of the bowel are re-established, and the absorption of water, electrolytes and nutrients can be maintained.^{4,10} Toxic products, which may be forming within the bowel as a result of the obstruction, as reported by Scudder, Zwemer, and Whipple,¹¹ can be removed by the suction. As suggested by the work of Glendel and Fine¹² in dogs, the physiological relief of the obstruction may result in the better maintenance of normal plasma protein content which is important in tissue metabolism, intestinal motility¹³ and wound healing.¹⁰ The net result of intestinal suction in obstruction is marked

clinical improvement in the individual patient and apparent reduced mortality for the group.⁸

significant information in identifying the character of the lesion.

A very definite benefit to the patient of

TABLE I

CHART OF EARLY CASES OF INTESTINAL OBSTRUCTION TREATED WITH THE MILLER-ABBOTT TUBE ARRANGED TO SHOW THAT GOOD CLINICAL RESULTS, AS MEASURED BY RELIEF OF SYMPTOMS, DEPENDED UPON SATISFACTORY SMALL INTESTINAL INTUBATION AND CONTINUED SUCTION RETURNS*

Case No.	Age	Diagnosis	Was X-ray Chart Made	Time Tube in Place	Volume of Suction Returns	Success of Small Bowel Intubation	Clinical Result
I	30	Lymphosarcoma with intestinal, peritoneal metast.	Yes	3 days	Fair	Poor; passed only into upper jejunum	Poor
II	48	Carcinomatosis carcinoma of pancreas	Yes	1 day	Fair	Poor; coiled in stomach	Poor
III	12	Acute appendicitis with perforation obst. postoperative	Yes	2 hours	Poor	Poor; coiled in stomach	Poor
IV	12	Perforated appendicitis: generalized peritonitis	No	3 days	Fair	Poor; toxic, often pulled out	Poor
V	52	Perforated ulcer with peritonitis	Yes	4 days	Fair	Poor; coiled in stomach	Poor
VI	42	Carcinoma, colon; peritonitis, postoperative	Yes	.....	Poor	Poor; coiled in stomach	Poor
VII	42	Peritoneal carcinomatosis with obstruction	Yes	2 days	Fair	Fair; passed slightly beyond duodenum	Fair
VIII	27	? Obstruction ? Hysteria	Yes	1 hour	.....	Poor; regurgitated after in duodenum	Poor
IX	75	Carcinoma of ascending colon	Yes	15 days	Good	Good; to cecum	Good
X	74	Carcinoma of jejunum	Yes	5 days	Good	Good; to lesion	Good
XI	62	Incarcerated femoral hernia	Yes	6 days	Good	Good; to cecum in 18 hours	Good
XII	27	Old postop. adhesions with intest. obstruction	Yes	8 days	Good	Good; to large bowel	Good
XIII	41	Cholecystitis acute and chronic	No	2 days	Good	Good	Good
XIV	13	Appendicitis intest. obstruction, postop.	Yes	4 days	Good	Good	Good
XV	28	Appendicitis, perforated postop. abscess, obst.	Yes	5 days	Good	Good	Good

* Since this chart was prepared, twenty-seven cases have been treated by intestinal suction. The results in these cases generally confirm our earlier impressions.

Diagnostic assistance in determining the type of lesion may be offered after the tip has passed to the site of the obstruction by introducing a small quantity of dilute radio-opaque fluid through the suction lumen to outline the lesion by roentgenography.^{6,8} This offers accurate visualization of the obstruction with the use of a minimum amount of contrast medium which may be immediately aspirated. Study of the intestinal contents aspirated from the region of the obstruction may also give

this type of therapy is that by producing an outlet proximal to the obstruction, the necessity of an enterostomy with its accompanying risk is obviated. In fact, decompression alone, as reported by Wangenstein and Paine,³ and often observed in postoperative obstruction caused by fibrinous adhesions, may result in complete relief of the obstruction which makes operation unnecessary.

In the postoperative management of certain cases the tube may have a useful func-

tion. If it is left in place during operation, the tip which can be felt within the bowel may be adjusted to a point proximal to the anastomosis. Thus, postoperative distention and risk of pressure on the intestinal suture line can be avoided by suction continued after the operation.

DISCUSSION

A review of the cases of intestinal obstruction in which the patients were treated with the Miller-Abbott tube at the Peter Bent Brigham hospital during the first two years shows that in a small group of patients good clinical results were obtained only if the tube was made to function properly. These patients in whom the tube worked well showed relief of distention, and improvement in nutrition and comfort. It is seen, however, that uniformly poor clinical results followed if the tube did not function properly. The most important factors causing unsatisfactory function of the apparatus were failures of the tip of the tube to pass the pylorus and to proceed along the bowel, or obstruction of the suction lumen, which is particularly likely because of its length and small size. Summaries of our early cases appear in Table 1. They are arranged to show the correlation between the above two causes of unsatisfactory function and the clinical effectiveness of the Miller-Abbott tube. Relief of clinical signs of obstruction was considered the criterion for a good result. All poor clinical results but one* (which was a case of multiple intestinal obstructions) were associated with improper function of the tube. In the light of our present experience from direct supervision of these cases, it is believed that mechanical difficulties in the use of the tube can be largely avoided and that good results may be expected with the proper technic.

* CASE 1. This was a male of thirty years who entered with emaciation, marked distention and evidence of obstruction. Exploration revealed widespread peritoneal lymphosarcoma. Abbott suction was used with effective intubation of the jejunum, but little relief of the distention. Autopsy revealed multiple sites of intestinal obstruction due to peritoneal metastases.

Although roentgenographic demonstration of the obstruction was not routinely attempted, it was shown to be effective in three cases, notably Case x in which a neoplasm of the small bowel was demonstrated. Convincing data on the value of this procedure have been published^{6,8} by Abbott and Leigh.

Postoperative intestinal suction was first used after a jejunal resection with good effect. It is now frequently employed and, with the adjunct of occasional gastric suction, gives good control of distention.

SUMMARY

The Miller-Abbott tube offers an ideal type of temporary therapy in cases of intestinal obstruction without strangulation. The clinical effectiveness of this treatment depends directly upon the skill with which it is used. An effective technic for the use of the Miller-Abbott tube and the care of the patient is presented.

We are indebted to Dr. Octa C. Leigh for our first Miller-Abbott tube.

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. . . It must be emphasized that *early* poliomyelitis may occur *without* any characteristic changes in the spinal fluid. If the patient presents a clinical picture in which one suspects poliomyelitis, treatment should be instituted despite failure to confirm the diagnosis by spinal fluid examination. In the absence of confirmatory findings in the spinal fluid, it is impossible to pronounce the case definitely as one of poliomyelitis; nevertheless, the patient should be given the benefit of the doubt and treated for this disease until further observation alters the diagnosis.

PNEUMOGASTROSCOPY

A PRELIMINARY REPORT

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WE have submitted this preliminary report on the technic of pneumogastroscopy as used by us at this time

opaque meal. Unquestionably, because of these limitations this method has contributed in a large measure to the failure of



FIG. 1. Stereoscopic view of stomach with expanded balloon and Miller-Abbott tube.

because we desire to make this simple procedure immediately available for use by other investigators. Our success with the technic encourages us to believe that its widespread use will increase the number of early discoveries of gastric cancer.

There are certain necessary limitations to the routine technic of roentgen examination of the stomach following the ingestion of an

early diagnosis in gastric cancer and other incipient lesions of the stomach.

For practical purposes, the normal stomach may be considered a flat, hollow, elastic muscle, lined with a special mucosa. When the stomach is filled with an opaque solution, the lining mucosa and the interior of the stomach itself are obscured from direct view during the roentgen examination. It is

true that mucosal defects may frequently be encountered when a small amount of highly radiopaque material is employed and when suitable methods of compression

of the disadvantages of the opaque meal and has, in addition, many advantages of its own in the proper and early diagnosis of gastric pathological conditions.



FIG. 2. Same as Figure 1.

are applied. But this technic demands a high degree of skill on the part of the examiner. The fluoroscopic findings so elicited are difficult to reproduce on the roentgenograph and the presence of obesity or thick abdominal muscles makes the examination difficult.

Were it not for the fact that most gastric lesions occur near the curvatures of the stomach and, therefore, can be thrown into relief on the projected roentgenograph, the use of an opaque medium would be without value.

NEW TECHNIC

We have successfully employed an extremely simple technic for the visualization of the interior of the stomach that has none

In our early work, we passed an ordinary Miller-Abbott tube into the stomach and insufflated a sufficiently large enveloping balloon with 250 to 400 cc. of air and 50 to 100 cc. of water which was employed chiefly as ballast. (Figs. 1 and 2.) Before and after the balloon had been insufflated, a thin mixture of rugar was given to the patient to swallow and this mixture was seen evenly compressed into the gastric mucosa by the expanding balloon.

Stereoscopic roentgenographs were then made, and we were able to view and place any suspected portion of the stomach under the most thorough roentgenographic scrutiny. The resulting radiographs, as can be seen in the accompanying illustrations, present a high degree of contrast. The thin,

opaque medium is finely dispersed and thrown into sharp contrast by the intense lucency of the injected air and the visual-

water ballast into the cap. This tube when expanded insufflates the entire stomach and is kept in place by the pressure of the

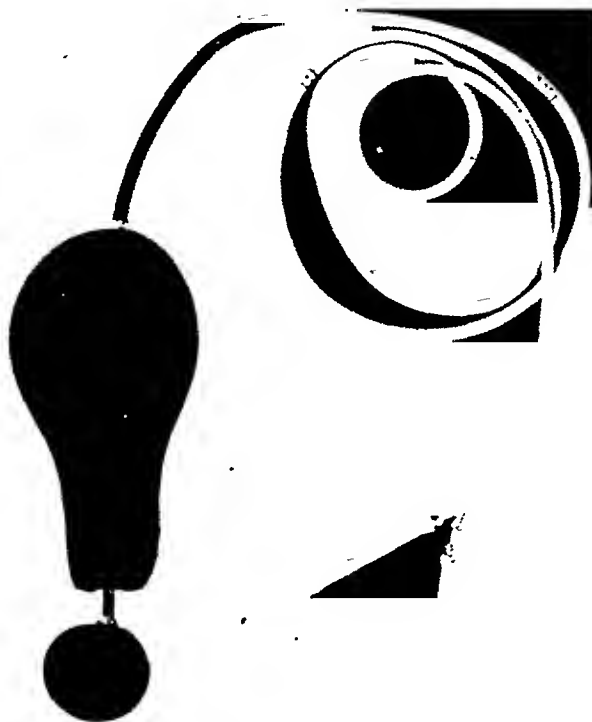


FIG. 3. Photograph of special tube used in pneumogastroscopy.

ization which results shows not only the curvatures but every part of the anterior or posterior wall of the stomach. Each part may be sharply demonstrated by the proper positioning of the patient and by the taking of stereoscopic views.

None of the patients complained of discomfort or any unusual symptoms other than those incident to the passage of the tube. They were unable to experience anything unusual as the stomach became expanded nor did they experience any discomfort at the release of pressure even when suddenly withdrawn from the expanded balloon.

This simple method described demonstrates a large portion of the stomach. However, for the proper visualization of the pyloric and prepyloric region we have employed our own specially designed tube which permits insertion of the tip and its

air in the stomach and the mass of the water ballast in the cap. We have not attempted to visualize the entire stomach with the simple method of attaching a balloon to a Miller-Abbott tube because of the danger of expanding the duodenum.

When the balloon is insufflated, it will naturally exert pressure in all directions and the cap obviously cannot take the same pressure as employed in the stomach. In our specially designed tube, the air is kept separated from the water ballast. Up to 50 cc. of water may be used as ballast in the duodenum and up to 500 cc. of air may be employed to expand the stomach.

ADVANTAGES OF NEW TECHNIC

In addition to making available for roentgen study the hitherto obscure inner recesses of the stomach, our method of

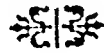
pneumogastroscopy has the following decided advantages over the simple opaque meal:

1. Clear and well defined small collections of barium are sealed into the defects of the mucosa by the gentle pressure of the expanded balloon. Such craters might quickly be swamped and obscured from view by a large mass of opaque fluid. These defects might also empty immediately after the passage of a fluid mass.

2. In the presence of gastric cancer whether scirrhus or fungating, there is loss of elasticity of the stomach wall. This is the

most characteristic and constant finding of stomach cancer. Up until the present, the cicatrix necessarily had to be of an appreciable size, large enough to produce a gross defect on the curvature of the stomach and large enough so that the examiner might note the interruption of the peristaltic wave. By our own technic, the cicatrix may be outlined extremely early in the disease. The wall of the stomach shows a marked alteration in its expansibility at the site of the cicatrix.

This tube is being manufactured by the George P. Pilling & Son Company, of Philadelphia.



THE patient with encephalobulbar poliomyelitis is much more acutely ill, and in a more critical condition than one with other types of poliomyelitis, and the prognosis is poor. A very frequent complication is pneumonia, usually due to aspiration of mucus from the paralyzed throat.

THE USE OF PROSTIGMIN IN ABDOMINAL AND VAGINAL OPERATIONS FOR THE RELIEF OF POSTOPERATIVE DISTENTION AND URINARY RETENTION IN A SERIES OF 96 CONSECUTIVE CASES*

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POSTOPERATIVE distention has always been a problem not only perplexing to the surgeon but distressing to the patient. The majority of patients having a laparotomy even in the hands of the most skilled operators have postoperatively, usually within from twelve to twenty-four hours, a functional inactivity of the gastrointestinal tract which may be followed by abdominal distention although the manipulation, if any, of the viscera has been very slight.

The most frequent causes of postoperative distention are trauma and exposure of the intestines to air during laparotomy. Undoubtedly, prolonged operations, rough manipulation of tissues, excessive handling of viscera, and long continued, unskilled administration of anesthetics are additional contributing factors in the etiology of this disorder. However, the actual mechanism of distention is still obscure.

We believe that the appearance of distention is a warning that the normal tonus of the digestive musculature has been lost. When motility of the gastric musculature is impaired the resulting atony is often followed by markedly increased secretion from the walls of the stomach or intestines. As absorption from the gut decreases the bowels become filled with large quantities of toxic fluid. As a result of the increased intraintestinal pressure, the blood vessels within the intestinal wall are compressed. This causes a complete impairment of peristalsis and results in acute gastric dilatation or paralytic ileus.

To prevent the above condition, treatment should be instituted as early as possible. It is of great value to recognize early postoperative distention and to distinguish it from obstruction. The former always develops within twenty-four or forty-eight hours after the operation while the latter develops several days after a laparotomy.

Of the large number of drugs which have been used clinically in attempts to stimulate peristaltic activity of the intestines the most important are those of the pitressin and surgical pituitary types and prostigmin. It has been our clinical experience that prostigmin has given excellent results in most of our cases.

Prostigmin, or the dimethyl-carbamic ester of m-oxyphenyl-trimethyl-ammonium-methylsulfate, is a chemical entity marketed in two parenteral forms, both of which were used in the present study. The "therapeutic" form, or prostigmin, 1:2000, contains $\frac{1}{2}$ mg. of prostigmin per cc. of solution. The "prophylactic" form, or prostigmin 1:4000, contains $\frac{1}{4}$ mg. of prostigmin per cc. of solution.

The use of prostigmin in our cases, preoperatively and postoperatively, reduced to a minimum the incidence of abdominal distention and proved to be effective in preventing paralytic ileus.

In our early series of cases, in which we used prostigmin twenty-four to forty-eight hours postoperatively at the onset of distention, our results, though fairly good, were not as satisfactory as those obtained when the drug was used preoperatively as well.

* From the Department of Gynecology, Service of Dr. I. Tractenberg, Unity Hospital, Brooklyn, New York.

TABLE I

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
1	R. G.	52	Supracervical hysterectomy	12 hrs. post-op. 1:2000 every 3 hrs. for 6 doses	Rectal tube	†	
2	S. L.	43	Total hysterectomy and perineorrhaphy	Pre-op. 1:4000, immed. post-op. 1:2000 and every 3 hrs. for 6 doses		†	No catheterization
3	B. F.	62	Vaginal hysterectomy and perineorrhaphy	Pre-op. 1:4000, immed. post-op. 1:2000 and every 3 hrs. for 6 doses		*	No catheterization
4	C. T.	41	Supravaginal hysterectomy	24 hrs. post-op. 1:2000 and every 3 hrs. for 6 doses		†	3 catheterizations required
5	A. B.	44	Supravaginal hysterectomy	Pre-op. 1:4000, post-op. 1:2000 and every 3 hrs. for 6 doses	Rectal tube	*	1 catheterization required
6	F. L.	44	Total hysterectomy and perineorrhaphy	Post-op. 1:2000 and every 3 hrs. for 6 doses		†	
7	L. M.	63	Hysterectomy and perineorrhaphy	48 hrs. post-op. 1:2000 and every 3 hrs. for 6 doses		§	Distention marked; catheterization required for 5 days
8	M. N.	48	Supravaginal hysterectomy, appendectomy and salpingo-oophorectomy	Pre-op. 1:4000, immed. post-op. 1:4000 and every 3 hrs. for 6 doses		*	1 catheterization
9	N. S.	52	Supravaginal hysterectomy and perineorrhaphy	12 hrs. post-op. 1:2000 and every 3 hrs. for 6 doses		†	1 catheterization
10	C. N.	56	Total hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 3 hrs. for 6 doses		†	1 catheterization
11	N. T.	54	Supracervical hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	
12	T. S.	51	Total hysterectomy	24 hrs. post-op. 1:2000 3 hrs. for 6 doses	Rectal tube and enema	†	
13	M. S.	61	Vaginal hysterectomy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 8 doses		*	
14	D. F.	43	Vaginal hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	

TABLE I (Continued)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
15	F. R.	68	Vaginal hysterectomy	Pre-op. 1:4000 post-op. 1:2000 3 hrs. for 6 doses	Rectal tube and enema	†	
16	B. R.	64	Vaginal hysterectomy	Pre-op. 1:4000 post-op. 1:2000 3 hrs. for 8 doses		*	
17	R. S.	69	Vaginal hysterectomy	12 hrs. post-op. 1:2000 3 hrs. for 6 doses	Rectal tube and enema	†	4 catheterizations
18	S. H.	52	Vaginal hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	
19	N. M.	49	Total hysterectomy and perineorrhaphy	Post-op. 1:4000 and every 3 hrs. for 6 doses	Rectal tube and enema	†	1 catheterization required
20	S. B.	58	Total hysterectomy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses	Rectal tube	†	
21	R. G.	43	Supracervical hysterectomy	24 hrs. post-op. 1:4000 every 3 hrs. for 6 doses	Wangensteen	§	4 catheterizations
22	P. O.	49	Supracervical hysterectomy left salpingo-oophorectomy and appendectomy	Pre-op. 1:4000 post-op. directly 1:2000 every 3 hrs. for 6 doses	Wangensteen	†	1 catheterization
23	M. M.	39	Supracervical hysterectomy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	
24	L. L.	59	Supracervical hysterectomy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	
25	J. F.	39	Supracervical hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses	Gastric lavage	†	
26	S. C.	31	Supracervical hysterectomy	Post-op. every 3 hrs. —6 doses pre-op. 1:4000	Levine tube	†	1 catheterization
27	B. O.	42	Supracervical hysterectomy anterior and posterior colporrhaphy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 8 doses		†	1 catheterization
28	L. F.	51	Supracervical hysterectomy and appendectomy	24 hrs. post-op. 1:2000 every 2 hrs. for 6 doses		†	

TABLE I (Continued)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
29	A. M.	43	Hysterectomy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		*	
30	E. S.	63	Vaginal hysterectomy (clamp)	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 8 doses		*	1 catheterization
31	C. F.	59	Vaginal hysterectomy (clamp)	12 hrs. post-op. 1:2000 given every 3 hrs. for 6 doses		†	4 catheterizations
32	T. L.	61	Vaginal hysterectomy (clamp)	Pre-op. 1:4000, 1:2000 directly post-op. given every 3 hrs. for 6 doses		*	
33	B. F.	64	Vaginal hysterectomy	1:4000 pre-op. 1:2000 directly post-op. given every 3 hrs. for 6 doses		*	1 catheterization
34	S. M.	28	Right salpingectomy and appendectomy	Immed. post-op. 1:2000 given every 3 hrs. for 6 doses		†	
35	J. L.	31	Bilateral salpingectomy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		*	
36	G. T.	23	Right salpingectomy and appendectomy	Immed. post-op. 1:2000 given every 3 hrs. for 6 doses	Rectal tube Levine tube	†	1 catheterization
37	I. J.	36	Bilateral salpingectomy	1:2000 directly post-op. given every 3 hrs. for 6 doses		†	
38	M. W.	32	Left salpingectomy; separation of adhesions	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		†	
39	M. E.	31	Bilateral salpingectomy	None given	Rectal tube; Levine tube; turpentine stupes	§	
40	M. F.	26	Right salpingectomy; separation of adhesions	24 hrs. post-op. 1:4000 given every 3 hrs. for 6 doses	Levine tube, enema	§	
41	W. G.	33	Bilateral salpingectomy; separation of adhesions	1:2000 given 36 hrs. post-op.		§	

TABLE I (Continued)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
42	B. T.	29	Bilateral salpingectomy; separation of adhesions	24 hrs. post-op. 1:2000 given every 3 hrs. for 8 doses		†	
43	S. O.	20	Right salpingectomy; resection of right ovary	1:4000 pre-op. 1:2000 post-op. given every 3 hrs. for 6 doses		*	
44	E. F.	19	Left salpingectomy and appendectomy	Pre-op. 1:2000 post-op. 1:2000 given every 3 hrs. for 6 doses		†	
45	T. L.	22	Right salpingectomy and appendectomy	Pre-op. 1:4000-1:2000 post-op. given every 3 hrs. for 8 doses		*	
46	I. W.	34	Right salpingectomy enucleation of a small fibroid	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		†	
47	M. P.	34	Right salpingectomy and appendectomy	24 hrs. post-op. 1:2000 given every 3 hrs. for 6 doses		†	
48	S. C.	36	Bilateral salpingectomy	None given	Rectal tube, enema	†	
49	M. T.	40	Bilateral salpingectomy, defundation	24 hrs. post-op. 1:2000 given every 4 hrs. for 6 doses		†	
50	R. V.	29	Left salpingectomy; uterine suspension	24 hrs. post-op. 1:2000 given every 3 hrs. for 6 doses		†	
51	Q. M.	38	Bilateral salpingectomy; defundation	Pre-op. 1:4000 post-op. 1:2000 given every 2 hrs. for 8 doses		*	
52	B. F.	52	Anterior and posterior colporrhaphy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		*	1 catheterization
53	G. K.	42	Anterior and posterior colporrhaphy and trachelorrhaphy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		†	
54	B. P.	56	Anterior and posterior colporrhaphy and hemorrhoidectomy	1:4000 night before operation 1:4000 pre-op. 1:2000 post-op. every 3 hrs. for 5 doses		*	
55	C. P.	36	Anterior colporrhaphy	1:2000 post-op. every 3 hrs. for 6 doses		*	2 catheterizations

TABLE I (Continued)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
56	I. M.	29	Posterior colporrhaphy and hemorrhoidectomy	1:2000 12 hrs. post-op. every 3 hrs. for 4 doses		†	
57	E. D.	48	Anterior and posterior colporrhaphy and trachelorrhaphy	12 hrs. post-op. 1:2000 every 3 hrs. for 6 doses		†	4 catheterizations
58 to 63	6 additional cases		Anterior and posterior colporrhaphy	1:4000 pre-op. 1:2000 immed. post-op. every 3 hrs. for 6 doses		*	No catheterizations
64	I. S.	24	Unruptured ectopic pregnancy	1:2000 12 hrs. post-op. given every 3 hrs. for 4 doses		†	
65	M. L.	26	Unruptured ectopic pregnancy	1:2000 24 hrs. post-op. given every 3 hrs. for 5 doses	Enema, rectal tube	§	
66	A. S.	36	Unruptured ectopic pregnancy	1:4000 pre-op. 1:2000 immed. post-op. every 2 hrs. for 6 doses		*	
67	M. W.	34	Ruptured ectopic pregnancy, intraabdominal hemorrhage	1:4000 pre-op. 1:2000 immed. post-op. every 2 hrs. for 8 doses		†	
68	G. H.	31	Ruptured ectopic pregnancy	1:2000 immed. post-op. given every 3 hrs. for 8 doses	Enema	†	
69	Z. F.	29	Unruptured ectopic pregnancy	None given	Enema after 2 days	†	
70	E. S.	14	Ruptured appendix, appendectomy	1:4000 immed. post-op. 1:4000 given every 3 hrs. for 8 doses	Rectal tube; Wangensteen	†	
71	M. P.	30	Appendectomy (ruptured), peritonitis	1:2000 post-op. every 3 hrs. for 16 doses	Wangensteen; turpentine stupes	†	
72 to 79	8 Appendectomies			1:4000 pre-op. 1:2000 post-op. every 3 hrs. for 8 doses		*	
80	B. A.	39	Ruptured appendectomy, peritonitis	1:2000 immed. post-op. 1:2000 every 3 hrs. for 12 doses	Rectal tube; Wangensteen	†	
81	S. G.	22	Ruptured appendectomy, peritonitis	1:2000 24 hrs. post-op. 6 doses for every 3 hrs.	Wangensteen; rectal tube	§	

TABLE I (Continued)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
82	M. F.	23	Cesarean (classical) section	1:4000 pre-op. 1:2000 post-op. every 3 hrs. for 6 doses		*	
83	C. M.	32	Cesarean (flap) section	1:2000 24 hrs. post-op. and 1:2000 every 3 hrs. for 6 doses		†	
84	D. V.	41	Cesarean (classical) section	1:2000 18 hrs. post-op. every 3 hrs. for 6 doses		†	
85	E. L.	29	Cesarean (classical) section	1:4000 pre-op. 1:2000 post-op. every 3 hrs. for 6 doses	Rectal tube	*	
86	N. A.	29	Repair of femoral hernia	1:4000 pre-op. 1:2000 immed. post-op. every 3 hrs. for 6 doses		*	
87	K. W.	38	Repair of femoral hernia and perineorrhaphy	1:4000 pre-op. 1:2000 post-op. and every 3 hrs. for 6 doses		†	
88	L. A.	33	Laparotomy for large ovarian cyst	1:4000 pre-op. 1:2000 post-op. and every 3 hrs. for 6 doses		†	
89	I. B.	26	Salpingo-oophorectomy appendectomy	1:4000 pre-op. 1:2000 post-op. and every 3 hrs. for 6 doses		†	
90	H. J.	38	Interligamentous cyst and appendectomy	None given	Enema, rectal tube; turpentine stupes; Levine tube	†	

KEY

* No distention.

† Some distention, the patient in a state of slight discomfort.

‡ Marked distention with intermittent relief.

§ Severe distention with no evidence of improvement for forty-eight hours.

In the ninety-six cases presented, the following operations were performed: fourteen supravaginal hysterectomies, six total hysterectomies, eight vaginal hysterectomies, eighteen salpingectomies twelve cystoceles and rectoceles operations eight salpingo-oophorectomies and appendectomies, twelve appendectomies (four ruptured), six ectopic pregnancies (two ruptured), four cesarean section, two femoral hernias, one laparotomy for pedunculated fibroid in a woman two months pregnant, four vaginal

hysterectomies (clamp method), and one laparotomy for very large ovarian cyst. Additional details concerning most of these patients are presented in tabular form.

CONCLUSION

In our series of ninety-six cases, the use of prostigmin has been followed by almost uniformly excellent results and in no instance produced untoward effects, either systemic or local.

FACIAL RECONSTRUCTION WITH ACRYLIC RESIN*

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IN the correction of gross anatomic defects such as the loss through disease or injury of a nose, cheek or ear, dentistry has made and is continuing to make important contributions. Artificial restorations made of various materials used in dentistry are particularly valuable in those cases necessitating radical corrective measures, in which the organ or part has been completely or largely removed.

Carcinoma involving the skin of the nose, for example, is a curable disease in its early stages, and the usual treatment by irradiation or surgery leaves only minor scarring. Yet, in spite of the intensive educational campaign of recent years, many carcinomas of this type are still permitted to reach an advanced stage. Treatment of advanced skin cancer entails great destruction of the involved area and subsequent restoration of the lost tissue by means of plastic surgery whenever possible. Plastic reconstruction, however, is often impractical for economic reasons or ill-advised because of the age and general debility of the patient. Even when such surgical reconstruction is indicated and the surgeon feels fairly sure that the disease has been cured, many months should be allowed to elapse before any attempt at plastic surgery is considered. This is a difficult period for the patient and he is ostracized from society. The prosthetic appliances advocated here are a means of returning the patient to society even before the wound is completely healed.

The cases illustrated here are those of patients with advanced carcinomas for which radical measures were necessary to eradicate the disease. In the same category one might place cases of gross destruction of soft tissue and bony structure caused by such infectious diseases as syphilis and

tuberculosis. Also, when facial parts have been destroyed in accidents and the age or economic status of the patient is a factor, a prosthesis of this type is most satisfactory, even if only as a temporary measure.

The restoration of lost parts of the face by the rapid and relatively inexpensive means of prosthetic appliances offers tremendous possibilities in injuries of war and accidents incurred in war industries. In the present world holocaust, reports and pictures from abroad indicate that there are many injured persons, both soldiers and civilians—even children—who will require rehabilitation by temporary or permanent restorations of this type. During the last World War interest in remedying facial defects by prosthesis was sufficient to warrant the formation of classes in many of our leading dental schools for instruction in what was then termed "war prosthesis." The type of injuries received as a result of present-day methods of warfare would indicate that a revival of interest in this subject is imminent, and with the new materials available, it will now be possible to make improved restorations with simplified technics.

In the cases presented here two different types of material have been used. In the first two cases the milky exudate of the rubber tree known commercially as latex was used, as described by one of us¹ in a previous article; in the third case, a new commercial product, one of the acrylic resins, was the material chosen. So far as can be ascertained from the literature, the material has not previously been used for this purpose except experimentally.

Reconstruction of facial parts with prosthetic appliances is not new. As early as 1905 Ottofy² suggested the use of materials employed by dentists. The idea, however,

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of an attempt to restore lost parts by an artificial contrivance probably dates back into antiquity. Ottofy constructed an

giving Clarke⁹ credit for first suggesting this material. The product originally used by both Bulbulian and ourselves was im-



FIG. 1. A and B, restoration of a nose with a prosthetic appliance made of latex (right). The organ was partially destroyed because of advanced skin cancer (left).

artificial nose of vulcanite, a combination of rubber and sulphur used as a denture-base material. Zinsser³ in 1913 published a formula which consisted chiefly of gelatin and glycerin, and in 1928 Bercowitch⁴ reported an improvement in this formula made possible by the addition of preserving and coagulating agents. Meanwhile there were scattered reports of cases in which vulcanite restorations were made, and again in 1935 several cases were reported by Batson⁵ in which a variety of facial defects were corrected with appliances made from the gelatin-glycerin combination. During the first World War numerous such restorations were made for injured French soldiers. The material used, as reported by Kazanjian,⁶ was electroplated copper. These appliances had the advantages of permanency and the possibility of added retention because various devices for anchorage could be soldered onto the material, and the obvious disadvantage of their unnatural appearance.

Very recently Bulbulian^{7,8} experimented with the liquid rubber compound, latex,

ported for commercial purposes; ours was obtained from a manufacturer of automobile parts. It is the same material used in making surgeons' rubber gloves and sponge rubber hospital mattresses. When it arrives in this country with only ammonia added as a preservative, vulcanizing and accelerating agents are added by the distributors. In this prevulcanized form it may be kept in a liquid state for some time if care is taken to keep the container tightly closed when not in use, as it automatically cures itself upon exposure to air.

The technic employed with latex is very simple. A mold in the negative likeness of the desired restoration is obtained as will be described later. It is filled with the liquid rubber which is then allowed to cure. The positive likeness thus obtained in semisoft rubber constitutes a restoration that has a texture and pliability not unlike flesh. This material was found by us to be superior to any previously recommended, the only difficulty being in coloring it to resemble human skin. A simple technic for the use of this material was reported last year¹ and it

was hoped that by this time the difficulties encountered in coloring would have been overcome. But despite the fact that an

C—COOH. This product comes to the dentist in the form of a pink powder, a white powder and a colorless liquid. By

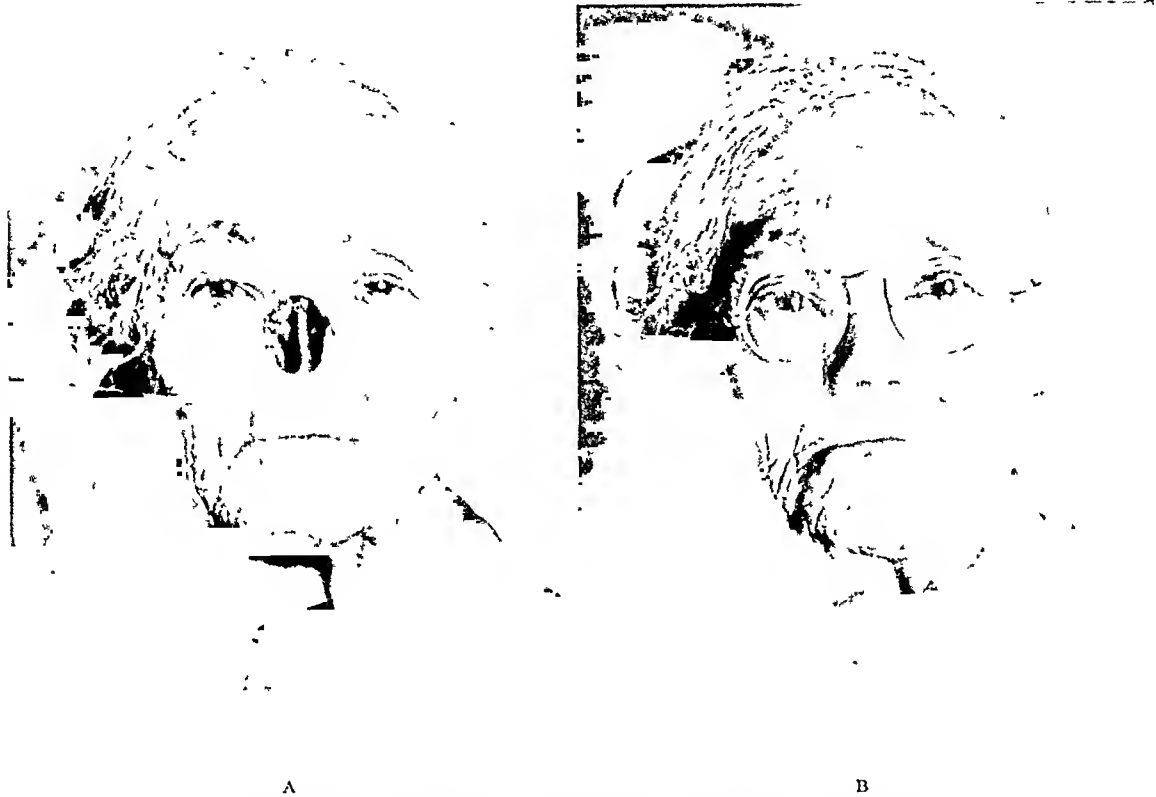


FIG. 2. A and B, latex restoration (right) made for another patient in whom very radical measures were necessary in the treatment of an advanced carcinoma (left).

improved product is now manufactured in five colors expressly for this type of work, the results are still far from satisfactory. In our hands the new product did not mold itself as well, nor could it be matched so well to the surrounding skin as the old product with the addition of dyes.

The restoration of a nose shown in Figure 3 was made with acrylic resin, a material now used extensively as a denture base. While several investigators experimented with acrylic acid derivatives prior to the year 1900, the material came into wide use in the arts and sciences in this country only as recently as 1939. The industrial development of these resins was due mainly to the research of Röhn¹⁰ of Germany who reported his investigations in 1900. In 1931 the acrylic resins first became available commercially in the United States. Acrylics is the term applied to the various resins made from polymerized derivatives of acrylic acid, $\text{CH}_2\text{:CHCOOH}$ and methacrylic acid, $\text{CH}_2\text{:}$ -

gradually blending the pink with the white powder and using the clear liquid as a binder, mixing and curing by the same process as is used in the making of a denture, a result is obtained that closely resembles the color of skin.

Acrylic restorations have been made for three of our patients and, although this material is tactually inferior to the liquid rubber, its advantages in color, cleansability and permanence would seem to make it the material of choice, at least for the present. The matter of expansion and contraction can be allowed for in the technic employed; however, there appears to be a trifle less shrinkage at present in the acrylic resin. The technic for its use as developed with the aid of Mr. John Lang of the dental department is as follows:

TECHNIC

First, a good impression is obtained of the area to be restored, together with as much of the surrounding tissue as is de-

sired. The impression is taken preferably with one of the hydrocolloids, particularly if any "undercuts" are present. This mate-

then invested in two parts by a technic familiar to every dentist, the first part being allowed to harden before the second



FIG. 3. A and B, restoration of a nose with an acrylic resin appliance (right). In this patient the nose was completely destroyed by surgical measures necessary in the treatment of cancer of the organ further complicated by tuberculosis (left).

rial melts at a fairly low temperature and causes little or no discomfort to the patient.

Next the impression is poured in plaster or artificial stone. The resulting cast is a positive likeness of the area remaining and the adjacent tissues. The missing portion, i.e., the part to be restored, is then carved in wax. On several of our cases this work was facilitated by taking an impression of the nose or ear of another person on whom this anatomical feature had a general resemblance to the one lost by the patient. This impression was likewise taken with hydrocolloidal material, but this time it was poured in baseplate wax. The wax nose can literally be shelled out. It is then further molded and carved to the esthetic appearance desired and adjusted to the plaster cast.

At this stage the patient is requested to return, the wax nose is tried on and further adjustments are made to harmonize with the patient's features. The wax pattern is

half is poured. The wax is then melted out, the two parts of the cast separated, cleansed thoroughly, allowed to dry, and both halves are foiled, molding the tinfoil carefully around the configurations.

A rather thick mix of the acrylic resin, of the same consistency as in making a denture, is now pressed between the two halves of the plaster cast, care being exercised to see that the mass fills all undercuts that may be present. The two halves are closed tightly and the acrylic resin is cured by submitting it to either moist or dry heat at a temperature of approximately 250°F., the same process as is required in making a denture of this material.

After the curing process is completed, the case is removed from the cast, polished and stippled to simulate the skin of the individual patient. If the restored part is very thick, as in the case of a nose, it may be hollowed out. This allows for better aeration as well as for the desired translucency.

Eyeglasses are used to aid in retaining the artificial nose on the face. Previously we have in several instances recommended the

harmony with the surgeon, who in most instances is an otorhinolaryngologist. The surgeon, bearing in mind the need for



FIG. 4. The artificial nose is retained in place by the shape of the defect and the use of eyeglasses. The acrylic resin nose is hollowed out for better aeration and greater translucency.

use of a thick makeup foundation covering the entire face for an improved esthetic result. With a restoration made of acrylic resin we believe that, aside from rouge and powder, no other cosmetics are required.

CONCLUSIONS

A means for the immediate restoration of anatomic facial defects is needed in those cases of disease or injury in which the extent of the defect and the age or economic status of the patient render reconstruction by plastic surgery impractical or ill advised. An ideal material for this work must first of all closely resemble the skin in color and translucency. It must not be irritating to the sensitive tissues with which it comes in contact; it must not change shape, it should be sanitary, and the technic required to construct the appliance should not be too complicated, thereby making the procedure too expensive. At the present time acrylic resin, with several advantages over liquid rubber, would seem to be the material of choice. It is hoped that a material having all the present advantages of acrylic resin plus pliability and a better texture will be evolved from further experiments with the new plastics.

For most satisfactory plastic and esthetic results, the dentist or technician who is to make the appliance should work in close

proximity with the surgeon, who in most instances is an otorhinolaryngologist. The surgeon, bearing in mind the need for harmony with the surgeon, who in most instances is an otorhinolaryngologist. The surgeon, bearing in mind the need for

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CEREBRAL COMPLICATIONS FOLLOWING SURGICAL OPERATION*

PREVENTION AND TREATMENT

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THE term, "anoxia," popularly calls to mind the image of a patient struggling for air. The face is livid and if an incision has been made, the blood welling up in the wound is alarmingly dark. In short, the patient is "cyanotic." This is a rather spectacular example of acute anoxia. The cause, as a rule, is evident and the treatment is obvious. There are, however, many circumstances under which a relative degree of anoxia may persist over a period of months or years. In such cases the symptoms are few and indeed they may be absent. Nevertheless, such a subacute or chronic anoxic state leaves a characteristic imprint on tissues in the form of increased fibrosis and cellular degeneration. Furthermore, it lowers the physiologic margin of reserve. The clinical manifestations of relative anoxia may be confined chiefly to one organ or system but study of the histologic pathology reveals evidence of widespread changes in every part of the body.

Appreciation of these facts is essential in devising a plan to aid in the prevention and treatment of cerebral complications which may follow surgical operation. We believe that "postoperative cerebral complications may occur as a result of cerebral anoxia; that the anoxia is usually secondary to an acute circulatory collapse precipitated by the administration of an anesthetic, plus the trauma of operation in individuals whose margin of circulatory reserve has been reduced."^{1,2}

The difficulties inherent in proper appraisal of the ability of some patients to withstand surgical operation are well known to all clinicians. We are not so much concerned about the obvious "bad risk." In such cases laboratory methods usually confirm clinical judgment. The experienced surgeon and anesthetist are prepared for any eventuality and take every precaution to safeguard the patient. Preoperative preparation, choice of procedure, of anesthetic and postoperative care usually receive special consideration. This additional consideration of the patient is extremely important and our cognizance of this may account for the relatively small number of cerebral complications occurring in the type of case in which they might be logically expected.

Not so simple to detect and possibly of greater importance are those cases of occult impairment of the patient's reserve powers. Such cases are usually difficult to detect clinically and may be unrecognizable even by laboratory methods at our disposal. It is not practical to subject each surgical patient to a great number of clinical or laboratory procedures to evaluate possible preoperative reserve. The expense and time consumed could be justified only if there were a reasonable chance of gaining valuable information, and at present such justification does not exist. In many surgical cases time would not permit of such preoperative evaluation. Finally, most of

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Read at the meeting of the National Association of Nurse Anesthetists, Boston, Massachusetts, September,

the clinical tests of visceral function are insufficiently delicate to detect latent alterations in physiologic function which may become significant only under the added stress imposed by surgical operation.

What preventive measures are available, then, against these postoperative cerebral complications which result from the additional anoxia of anesthesia and surgical procedure on patients with latent circulatory insufficiency?

Surgeons and anesthetists should be prepared to accept the fact that even in the absence of clinical signs, relative degrees of anoxia exist in many patients requiring surgical operation; the patient who has chronic cardiocirculatory disease, the patient who is anemic, the patient in shock, the patient with hyperthyroidism or diabetes mellitus, the jaundiced patient, the patient with diarrhea or vomiting—all those and many others suffer from varying degrees of tissue anoxia. In such cases surgical operations almost invariably superimpose additional anoxia.

The surgeon must exercise eternal vigilance before, during and after operation. At times this is extremely difficult to maintain. This is especially true when the surgeon must accept the responsibility not only for the performance of the surgical operation but also for the administration of the anesthetic. Nevertheless, a high degree of co-operation between anesthetist and surgeon can be obtained if the surgeon receives a periodic verbal report as to the state of the pulse, respiratory rate and blood pressure during the operation. The surgeon should never hesitate to abandon the operative procedure temporarily and to devote his entire attention to the measures which will restore normal respiratory and circulatory function in the anesthetized patient. This may require intravenous therapy, blood transfusion and introduction of an intratracheal catheter, aspiration of the air passages or mechanical methods of aiding respiration. In many instances, the temporary abandonment of the operation, the removal of retractors, the covering of the

wound with hot moist packs and a two or three minute rest period, suffices to raise the blood pressure toward normal levels. The tendency to add speed in an effort to complete the operation in the face of a falling blood pressure is to be deplored; most commonly this results in added trauma and greater drop in the blood pressure.

The importance of maintaining a comparatively (for the individual patient) normal blood pressure during operation has already been suggested. Blood pressure reflects the tone of the circulatory system and gives early intimation of impending circulatory collapse. If the operation is of such magnitude that an appreciable fall in blood pressure must be anticipated the prophylactic infusion of intravenous fluids should be begun before the skin incision is made. Fluid is usually administered in the form of 5 per cent dextrose solution and may be supplemented by whole blood when necessary.

Spinal anesthesia is becoming more and more popular and justly so, but it requires a special word of caution. Spinal anesthesia commonly produces depression of the blood pressure. While in many cases the cerebral manifestations of such a drop may be absent, or at most, confined to a more or less severe postoperative headache, the surgeon must not lose sight of the fact that such depressions of blood pressure are potentially dangerous since depression of blood pressure implies temporary insufficiency of blood flow and, therefore, relative oxygen lack to essential viscera. In most cases the use of ephedrine sulphate or neosynephrine hydrochloride is almost uniformly effective in restoring the blood pressure to its preoperative level. However, caution must be used in administering these drugs when the blood pressure has fallen to or below the critical level, since the vasoconstrictive effect of the drug may accentuate the effect produced by pooling of blood in the venous system.

Equally important as the maintenance of blood pressure is an adequate supply of

oxygen during the operative and postoperative periods alike. Obstruction of the airway from any one of a number of causes may bring about serious embarrassment to respiratory function during and after the course of an operation. Such obstructions are particularly common in operations upon the nose and throat, the thyroid gland, and in an emergency in which an anesthetic must be administered without benefit of a preparatory period of starvation. The value of oxygen therapy in the treatment of many medical and surgical diseases has long been recognized. Perfection of newer methods of administration of the gas such as the B. L. B. mask which promotes the administration of oxygen in concentrations of almost 100 per cent has extended its availability. The wider use of oxygen therapy in the immediate postoperative period in which it is warranted by severity of the operation, lowered blood pressure and rapid pulse, dyspnea or cyanosis, and in cases of severe anemia, serves to prevent postoperative complications.

There has been a growing tendency in recent years toward the wider use of hypnotic and sedative drugs, particularly of the barbiturates in the preoperative period. The judicious use of such drugs doubtless helps to maintain the psychic equilibrium of the nervous patient before operation. Too often, however, such large doses of drugs are used that the patient comes to operation with a greatly depressed respiratory center and a state of subacute anoxia already present. Such patients, when subjected to the additional anoxia of anesthesia, become potential victims for regrettable and avoidable cerebral accidents. Too much emphasis cannot be placed upon the danger of overdosage with barbiturates and opiates in daily surgical practice, as well as in obstetrics.

Of prime importance in the prevention of cerebral accidents is a thorough knowledge of the factors which might precipitate such complications. While there is some excuse for failure to carry out a multitude of laboratory procedures, there can be no

excuse for failure to obtain an accurate history and to perform a careful physical examination in each patient prior to operation.

It becomes clearly evident, then, that it is of greatest value to the surgeon and anesthetist to be constantly on the alert for cases which may be predisposed to postoperative cerebral accidents; they must always bear in mind that such possibility exists. The surgeon who states that he does not see such accidents in his practice is either doing very little surgery or does not recognize the true nature of the accidents when they occur.

TREATMENT

The treatment of postoperative cerebral accidents is discouraging. An ounce of prevention in these cases is worth many pounds of treatment. Too often the changes produced by oxygen lack are irreversible but milder forms of cerebral complications, namely, the confusion states, the postoperative psychoses and even many of the muscular disturbances may often disappear as the general condition of the patient improves.

Evidence of the existence of some type of cerebral accident dependent upon anoxia may occur while the patient is still in the operating room. At other times such evidence in the form of postoperative psychosis, convulsions or hemiplegia does not become manifest until several hours or days after the operation. Their occurrence calls for the use of the same measures which are important in the prevention of cerebral complications, namely, the maintenance of blood volume, the support of the circulatory system and the administration of adequate oxygen. Blood volume is best restored by transfusion of whole blood or blood serum, while oxygen may be administered by any of the methods commonly in use, preferably by mask or tent.

When cerebral accidents occur, knowledge that they are central nervous system manifestations of general circulatory insufficiency should guide treatment. Many

patients are harmed rather than helped by treatment aimed at overcoming hyperactivity of the central nervous system by the use of morphine, barbiturates or spinal drainage. Such treatment only leads to further circulatory depression.

SUMMARY AND CONCLUSIONS

1. Emphasis has been placed on the importance of recognizing the type of case which is a potential victim of cerebral postoperative complications.

2. Measures designed to prevent such accidents have been discussed.

3. The treatment of cerebral complications has been discussed and the injudicious use of morphine derivatives and barbiturates is condemned.

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THE prognosis in poliomyelitis is more favorable in children under three years and in adolescents over fifteen years. Our chief objective at the present time is early diagnosis and prompt and repeated injections of large concentrated potent doses of convalescent serum into the veins.

THE TUBED PEDICLE GRAFT IN FACIAL RECONSTRUCTION

ITS SUPERIORITY WHEN SUBCUTANEOUS LOSS IS PRESENT

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A DISFIGUREMENT of the face or neck often results in social ostracism and economic distress. The plastic surgeon has the opportunity to restore the disfigured area or areas to normalcy so that activities, social and professional, may again be resumed. The desire to be normal in appearance is not of recent origin. It is as old as history. The economic necessity to be normal in appearance is being more and more emphasized. The economic competition of our present age demands physical fitness. Disfigurements of the face are handicaps which cannot well be overcome in the competitive life of our present time. The plastic surgeon in his choice of tissue transfers can correct the disfigurement and give to the unfortunate individual a new outlook on life.

The development of the tubed pedicled graft has solved many problems in plastic surgery about the face. Plastic surgery about the face entails a more exacting choice of operation and more precise technic than do similar reconstructive operations elsewhere on the body. Particularly is this so when the subcutaneous tissues have been destroyed or must be excised because of existing pathological changes.

When there has been no loss of subcutaneous tissues, the free full thickness graft may be found an easier and a fairly satisfactory covering for an excised disfigurement. However, for those facial disfigurements associated with a subcutaneous loss of tissue, the tubed pedicle flap offers far more satisfactory results.

CASE REPORTS

CASE 1. The patient was a man fifty-eight years old who two and a half years previously developed a lesion of the left inframandibular

region which was diagnosed as malignant. He was subsequently given a series of x-ray treatments. Following the x-ray therapy the tissue broke down leaving a chronic ulceration which had refused to heal under various methods of treatment. At the time he was referred to my office he had a superficial ulceration of the skin 3 cm. in diameter. The surrounding skin over an area of 8 cm. was firm, adherent, fibrotic and atrophic. Surrounding this fibrous skin area was a margin of small telangiectatic vessels. The impression was an x-ray burn. A section was removed from the edge of the ulcer to rule out any possibility of recurrent malignant ulceration.

The case illustrates the economic difficulties of even a relatively minor disfigurement. This man was a salesman. He had experienced difficulty obtaining any position because he constantly had to wear a dressing over the ulcerated area. When he did obtain a position, it was usually only a short period of time until he would be discharged. He found it more and more difficult to obtain an interview and to hold the attention of the prospective customer while wearing a dressing on his face. Because of the economic struggle he was forced to seek relief by plastic surgery.

Under local novocaine infiltration anesthesia the tube flap was made extending from the tip of the aeromium to the pectoral area. After an interval of three weeks, under general anesthesia the avascular fibrous tissue was excised until normal vascular tissue was reached. The pectoral end of the tube was then cut free from its attachment and the distal half of the tube was opened out. It was sutured into the defect. The tubed graft healed in position as illustrated. It has now established a local circulation and could now be freed from its tube attachment.

The patient, however, refuses to have the remainder of the tube removed. He fears that there might be a recurrence of the malignancy. In such a case the area could be excised and the remainder of the tube sutured into the defect.

The presence of the tube causes no inconvenience. It is entirely covered by his clothing and in case of further need a good sized piece of skin will be ready for grafting.

of the face with adherent scarring, chiefly of the left cheek. The skin had not only been destroyed but also the subcutaneous fat so that the scarred skin was adherent to the bony



FIG. 1. Case 1. X-ray burn following malignancy of left inframandibular region. A graft three by eight inches in size has been made into a tubed graft, extending from the shoulder to the pectoral area. After three weeks it is ready for transferring to the recipient area.

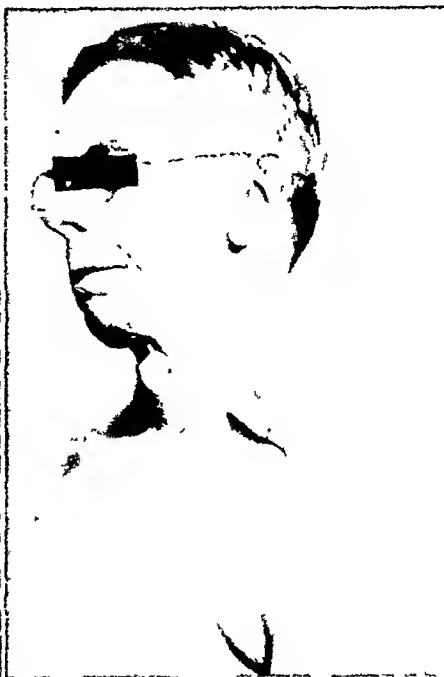


FIG. 2. Case 1. The x-ray burn with its adjacent avascular fibrous tissue has been excised. The pectoral end of the tubed graft was cut across and the distal half of the tube opened and sutured in the defect. The unused portion of the tube could now be excised and the medial edge of the graft resutured for improved appearance.

Such burns as this require a different principle of treatment from those of the usual skin defect. The roentgen rays destroy malignant and normal cells by causing a proliferation of the endothelium of the blood vessels in that area. The local tissues become ischemic. The free skin grafts will not survive because of the lack of blood supply to the area and the resultant diminished nutrition. Under such conditions the graft should always be a pedicled one with its own sufficient blood supply.

CASE 11. The patient was a seventeen year old girl. She stated that when she was a small child she fell against a red hot heating stove. The skin over the left side of the face and forehead was so burned that it was said "the skin stuck to the stove when she was pulled away from it." The result was an asymmetry

structures. Ectropion of the lower lid was present. The eyeball was not injured.

It was believed that although the defect might be repaired by a free skin graft, because of the necessity for replacement of subcutaneous tissue the tube graft offered a far greater improvement, so that the more complicated procedure appeared advisable. The simpler type of operation using a full thickness free graft would have improved the condition. The free flap would have had less subcutaneous replacement than was required. It is very probable that it would have been followed by pigmentation to a varying degree over the grafted area. For these reasons the tubed graft was advised.

The tube graft differs from all other forms of delayed skin flaps in that it prevents the formation of granulation tissue

and subsequent scar tissue on its deep surface. As a cosmetic flap it cannot be surpassed where large quantities of skin are



FIG. 3. Case 11. As a small child the patient fell against a red hot stove. The result was a loss of subcutaneous tissue as well as the disfiguring scars. The right cheek, supra-orbital area and the forehead were scarred.

required. It can be transferred from a distance with readiness and safety by temporary attachment to an intermediate host such as the hand or forearm.

The chief disadvantages of the tubed graft is the time factor and the necessity for multiple operations. The financial aspect of necessity enters into any procedure involving multiple periods of hospitalization. This may seem to the less experienced surgeon an urge to shorten the period between stages, which inevitably leads to disappointment and greater delay. While the periods of hospitalization may often be safely shortened for economic reasons, the length of time between the stages must not be shortened without danger of loss. It is easy to misjudge the

variability of a flap even when the time interval appears correct. As a rule an interval of three weeks between the time of making of the tubed flap and its transference is sufficient. The transference of one end to the hand, and later to the face and again the severance of the unused portion of the tube will require a period of nine weeks. If the entire tube is to be used, another two weeks' period will be required.

TECHNIC

The flap is cut according to pattern but on the liberal side so that later when the flap is thinned to conform to the adjacent structures, the margins may be excised and a more satisfactory suture line obtained. This again can best be done in stages. At each stage the opposite sides of the graft are raised, thinned and resutured. This results in decided improvement in the cosmetic results.

As in all types of skin grafts to exposed areas of the body, color and texture match are very important. An exact pattern is helpful and the pattern should be placed so that Langer's lines conform in both the donor and recipient areas. Before the tube is formed a mesh gauze is placed over the area which is to be replaced by normal skin. With one of the dye antiseptics an outline is made on the gauze. The gauze is then placed over the donor site and the entire area painted with the dye. The tube to be formed may not exceed the required width and when it is later reopened it may more easily be made to conform to the defect, particularly if the defect is irregular in outline.

The tubed flap should be handled with the same care as a free full thickness graft. It should not be pinched with forceps in any stage of its transfer. Sutures or hooks are much safer for transferring the flap and holding it in position for suturing.

The tubed flap first described by Filatoff in 1917 but popularized largely by Gillies and others, has become more and more generally used in plastic surgery.

In making the tubed flap two parallel incisions two and a half to three inches in width, depending upon the size desired, are

increases during the three weeks' interval between first and second stages. At the end of three weeks the tubed flap should be



FIG. 4. Case 11. A tube of skin measuring three by eight inches was made below the right breast.



FIG. 5. Case 11. After three weeks the medial end of the tube was cut across. An incision was made along the ulnar side of the left hand and the end of the tubed graft sutured to this incision.

made through the skin and subcutaneous tissues. The direction of the parallel incisions should be parallel with the general course of visible veins or over the area in which known arterial branches are present. An infra-red photograph of the donor area may be a help in determining the exact direction and abundance of the superficial veins, which may not be demonstrable by the usual examination. Some surgeons have set a length of eight inches as the maximum for the tubed flap. The viability depends not on exact measurements but in the evident arterial supply and the venous return. The tube flap can be made longer in the thin individual than in a fat person. The horizontally inclined vessels are all cut across by the parallel incisions so that the flap receives its entire blood supply only from the longitudinal vessels entering each attached end. With the loss of the lateral circulation, the longitudinal blood supply

viable, so that when one end is severed and attached to its recipient site or to an intermediate host site, the circulation from the one end is sufficient to nourish the entire tube until it again develops an additional longitudinal circulation through the end which was transferred. This again will require a period of about three weeks.

When the tubed flap must be transferred to a distant part of the body, the hand or wrist may be safely used as the intermediate host. The part of the hand or wrist decided upon will depend upon the location of the recipient area and the greater facility with which one portion of the hand is best suited to the recipient area. As in Case 11 the ulnar side of the hand was decided upon as the resulting scar would be in a relatively inconspicuous location and when the palm of the hand was placed along the side of the

head it was not in a cramped position, and the tube could be attached to the recipient area without any interference from the

inguinal region. Because of the direction and abundance of the blood vessels a longer tubed flap can be safely made or the dura-



FIG. 6. Case 11. After another period of three weeks the other end of the tubed graft is cut loose from the body. The disfiguring scar of the left cheek was excised. The distal half of the tube was opened out and sutured in the defect. The arm and body was enclosed in a plaster cast.



FIG. 7. Case 11. Two years later. The graft has been thinned and resutured in stages. The supra-orbital scars were excised as well as those of the forehead.

hand and without undue torsion of the tubed flap.

When greater areas of skin are required than can be furnished by an eight inch tube of skin, the tube may originally be left attached in the middle as well as at the ends during the first stage. This middle attachment is then sutured to the hand at the end of three weeks. Then after a second three weeks' interval the two ends are freed and attached to the distant recipient area.

The donor sites will be decided upon by the requirements of the recipient area. For a woman's face the area should be hairless and the texture of the skin should be similar. If large areas of skin are the only requirements for the individual case, a large tube can be satisfactorily made when it extends from the lateral thoracic region to the

tion of the first stage interval for a short flap may be safely shortened.

There are a number of additional points of importance to be observed in making a tubed graft. Hemostasis in the tube itself must be absolute. Bleeding vessels should be ligated with fine silk or catgut. Capillary oozing is controlled by hot packs. Any excess of fat should be trimmed away before the suturing is started so that in suturing the tube no undue tension nor constriction of any part of the tube will result. A suture placed near each end of the proposed tube will facilitate handling and suturing of the remainder of the tube. The sutured tube may then be retracted to one side by a gauze tape while the donor area is prepared for closure. By undermining the skin of either side the donor area can usually be closed without great difficulty. If upon closure of the donor area undue tension on the skin appears evident, subcutaneous sutures of silk or catgut will

relieve the tension on the skin sutures. If hemostasis has been carefully observed, no drain should be used in the donor area. The donor incision is covered with sterile gauze and the tubed flap is wrapped in vaseline gauze. Pads are placed on either side of the tube so that pressure on the tube itself is prevented. The additional dressing should not produce any mechanical interference with the circulation of the tube. The dressings are held in position either with loosely fitting adhesive tape or a gauze binder.

Very little postoperative care should be required following the first or second stage. Seldom will a dressing be required before the fifth or sixth postoperative day, if upon inspection the attached ends of the tube are normal in appearance. If one end of the tube appears cyanotic, reddened or edematous, the dressings must be removed at once and a hematoma searched for. Gentle massage at frequent intervals may be useful in relieving temporary passive congestion, until a better circulation can be established. Technical failures in using the tubed graft are usually the result of ischemia. Poor judgment in the size and construction of the tube, too tight suturing of the tube and too early transference of one end to its new location are among the causes of ischemia. With proper attention to details the tubed graft offers superior possibilities for the restoration of the nose, ears or defects in skin and subcutaneous tissues of the face and neck.

While the duration of the entire series of operative procedures may cover what appears at first glance to be an unreasonable period of time, the results may well repay one for the additional period of hospitalization and disability. The periods of hospitalization for each stage are relatively short. In Case 11 all stages were carried out under local anesthesia. For the first stage five days of hospitalization were required, for the second stage two days' hospitalization. For the third stage four days, the fourth stage two days, and for the later stages of thinning and resuturing one and two days each were required. This is a total of eighteen hospital days, not a much

greater period of hospitalization than for many of the common run of major surgical operations. The greater period of weeks of inactivity may seem prohibitive, yet it must be remembered that most of these patients for whom the tube graft is required because of the existing disfigurement have not been able to obtain very remunerative occupations, hence the loss in time diminishes in importance.

SUMMARY

The importance of the tubed graft cannot be overemphasized in reconstructive surgery of the face and neck.

Tubed grafts when properly performed result in excellent cosmetic improvement. Better results than can be obtained by the use of free full thickness grafts should compensate the patient for the greater period of disability.

This combination of relatively simple operations under local anesthesia should relieve the patient of a disfigurement which has been a source of mental anguish and an economic handicap for years.

The multiple-stage tubed graft procedure while covering a long period of time, actually requires little more hospitalization than the average major surgical procedure, and the loss in time is usually of relatively little economic importance to the patient.

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RABIES*

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RABIES probably causes fewer human deaths and yet is associated with greater fear and hysteria than any other known disease. While in the United States there occur less than one hundred deaths each year from rabies—for ten years from 1924 to 1933 there were 746, an average of less than 75 per year—the average deaths from appendicitis is 15,000 and about 34,000 people are killed in automobile accidents each year.

Recent publications^{1,2,3} have raised the question as to the effectiveness of the Pasteur prophylactic treatment and as to whether this therapy is necessary.

Because of the confusion which exists in the minds not only of the laity but of the profession concerning the value of treatment and the proper care of animal bites, it would seem wise to review certain facts about rabies and its effective prevention:

There is no report of spontaneous recovery in man with rabies.^{4*} There is no report of man contracting rabies after being bitten by a rabid human. Recoveries in dogs, rabbits and guinea-pigs have been noted and in certain instances in which the disease was proven. Every kind of animal is susceptible to the disease, even birds may contract it. Rabies is perpetuated in civilized communities almost exclusively by the domestic dog and, to a small extent, by wild animals of the dog family.

Prevalence. Rabies exists practically all over the world. It has, however, never been known in Australia due to a rigid quarantine on dogs. It has not been reported in Denmark, Norway and Sweden for more than fifty years. In the United States in 1890, there were 143 deaths in thirty states;

in 1933 there were sixty-five deaths. In England during 1895, 672 cases were reported in dogs with twenty human deaths. By improving the muzzling law this was cut down in three years (1898) to seventeen cases of rabies and two human deaths. In 1903, the disease was completely wiped out in England; however, due to the transportation of dogs across the Channel during the World War by aeroplanes, rabies reappeared in 1918.

Incubation. The period of incubation is long and varies from fourteen days to one year or more. The prolonged periods of incubation denote latency. The average period in dogs is twenty-one to forty days, while in man it is forty days. In children incubation seems to be shorter as it also is after bites on the face. The length of time between the bite and the onset of symptoms depends upon the amount and the virulence of the virus and the nature and site of the wound, especially with reference to its nerve supply. It requires about fifteen days to induce active immunity to the disease by means of the Pasteur preventive treatment.

Virus. The virus occurs principally in the saliva and in the central nervous system. It may be present in the saliva four to twelve days before the dog shows symptoms. It is, therefore, sufficient to watch a dog that has bitten a person for fourteen days and if no symptoms of rabies appear in the dog during this time, there is no danger of the disease having been transmitted and the Pasteur prophylactic treatment is unnecessary. Practically the danger from a bite during the preclinical stage is very slight.

The virus enters the system through the broken skin and follows the course of the

* In this discussion we have drawn freely from "Preventive Medicine and Hygiene" by Rosenau.

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nerve trunks from the site of injury to the spinal cord and thence to the medulla and brain. The route is the same as in tetanus toxin.

Relative Danger of Bites. Bites on exposed surfaces are more dangerous than through the clothing because the saliva is wiped from the teeth by the clothing and little or none enters the wound. Bites upon the face are most apt to be followed by rabies. There is no authentic report of the transmission of the disease by a human bite, although this might be possible.

Prevention. To control the incidence of the disease and the fatal results, there are three methods: (1) treatment of the wound; (2) Pasteur prophylactic treatment and (3) control of the disease in dogs.

Treatment of the Wound. Wounds produced by the bite of an animal which might possibly have rabies should at once be cauterized with fuming or strong nitric acid. Cabot reports that he saved 91 per cent of guinea-pigs from the disease by cauterizing the bite with nitric acid after twenty-four hours had elapsed. Rosenau finds that practically all guinea-pigs can be saved by the prompt application of nitric acid, that its effectiveness decreases with time, but that it is partially protective up to forty-eight hours. No other cauterizing substance gives equally good results.

Pasteur prophylactic treatment was first announced on December 6, 1883. The principle of treatment rests on producing an active immunity by means of a modified virus which has been attenuated by drying. The fixed virus contained in the spinal cord of rabbits dead of hydrophobia is emulsified and injected subcutaneously. This classic method of Pasteur has been modified in various ways in regard to the manner of attenuating the virus. The Semple method is fast becoming the method of choice on account of its simplicity and apparent effectiveness. In this method the spinal cord and medulla is made ineffective by carbolic acid. The dose is 2.5 cc. injected into the subcutaneous tissues of the abdominal wall once a day for fourteen days. All doses are

the same regardless of age, sex, severity of the bite or location of the wound.

Care during Treatment. It is not necessary to keep the subject in bed. He may go about his usual occupation. Fatigue, cold, emotion, stress, trauma and alcohol should, however, be avoided. It was found that custom's officers returning to the Siberian borders after prophylactic treatment for wolf bites, showed an unusually high mortality which seemed to be due to exposure to cold. The disease has been known to occur after the shock of falling in cold water and in alcoholism.

IMMUNITY

Duration. Immunity appears about two weeks after the treatment and lasts a varying period of time. The treatment, therefore, should be repeated after a second bite.

Nature. The nature of the immunity is not clear. That it is not an antitoxin is certain.

Degree. The treatment usually affords definite protection but it sometimes fails. The antigenic value of the material used is open to question in the failures.

Contraindications. There are none.

Indications. (1) If the dog is mad, begin at once with treatment. (2) If the dog shows symptoms suggestive of rabies, begin treatment at once. (3) If the dog is not mad, observe the animal closely for fourteen days and if no symptoms develop there is no danger of the person bitten contracting the disease. (4) If the dog cannot be identified, the rule is to advise treatment except in regions known to be free of rabies.

CONTROL OF RABIES IN DOGS

Muzzling. The consistent muzzling of all dogs for two years would practically exterminate rabies.

Quarantine. A quarantine, to be effective, should be imposed for six months due to the long period of incubation.

The Stray Dog. It is largely the stray dog which keeps rabies in existence.

DIAGNOSIS

The diagnosis of rabies is based on (1) symptoms, (2) the presence of Negri bodies in the central nervous system, (3) lesions in the peripheral ganglia and (4) animal inoculations.

The symptoms may be very suggestive, but cannot be depended upon for diagnosis. The course of the disease may be divided into three stages: (1) Premonitory stage, (2) a stage of excitement, and (3) a paralytic stage.

The first two stages may be absent or transient. All rabid animals become paralyzed before they die. Dogs suffering from a furious rabies have a tendency to run long distances (even twenty-five to fifty miles) often biting and inoculating large numbers of animals and persons en route.

Negri bodies are found especially in the Horn of Ammon and the cerebellum; they vary from 1 to 3 micra in size, are usually round or oval, strongly eosinophilic and occur within and without the nerve cells; they sometimes contain nuclei.

The lesions in the peripheral nerves consist of round cell formation.

The final diagnosis rests upon animal experimentation. A small quantity of an emulsion of the medulla or pons of the suspected animal is placed under the dura mater of a rabbit or guinea-pig. The diagnosis by this method requires such a long time that it is of no practical value in deciding whether or not to administer the Pasteur treatment. However, in a critical case the positive evidence provided by this method is final.

Leach, the Field Director of the Rockefeller Foundation State Board of Health of Montgomery, Alabama,⁵ has shown that microscopic examination of the brain for Negri bodies is not entirely dependable. He found in 1,032 animal brains, 338 positive, 690 negative and four questionable for Negri bodies. Of the 338 positive brains, three were negative on mouse inoculations and of the 690 negative for Negri bodies, eighty-three (12 per cent) showed rabies on

mouse inoculation. Of the four questionable on microscopic examination three were positive by inoculation.

IS IT NECESSARY TO TREAT BITES FROM RABID ANIMALS?

Not every person bitten by a rabid animal develops rabies. No recent figures are available concerning the proportion of those bitten who received no prophylactic treatment and yet did not become ill with the disease. The statistics are difficult to analyze and now it is almost impossible to collect data of persons bitten by mad dogs and not treated. The mortality ranges from 6 to 51 per cent. (Table I.)

The importance of early treatment has been well shown by Park and Williams.⁶ (Table II.) Here the mortality of 1-1000 in over 6,000 cases treated within five days, mounts rapidly to 1-30 in 313 cases treated after three weeks.

TABLE I
MORTALITY FROM BITES OF RABID ANIMALS WITHOUT
PROPHYLACTIC TREATMENT

Author	No. Cases	Deaths	Mortality Per Cent	Ratio
Leblanc			16.6	1-6
Park and Williams			10.0	1-10
Paltauf			6-9	
Faber	339	27	8.0	1-12
Kurimoto			17.0	1-6
Babers	995	130	15.0	1-7
Horsley			15.0	1-7
Tardieu	855	399	46.0	1-2
Bouley	266	152	51.0	1-2

This is also shown in the League of Nations report (Table II) in which the mortality is doubled in those cases treated after fourteen days.

The eight analytical reviews of Reports from Pasteur Institute⁷ on the results of antirabies treatment, cover 758,182 persons who have received the treatment with 2,743 deaths, a mortality of 0.36 per cent, or one in 300 persons. In this group, 10 per cent of biting animals were proved rabid by

experiments, 13 per cent certified by medical or veterinary physicians, 73 per cent suspected to be rabid and 4 per cent not suspected to be rabid. To date this is the most comprehensive report available and will be drawn upon largely in the following discussion.

TABLE II
MORTALITY IN RELATION TO DELAY IN STARTING
TREATMENT

Author	Days Delay	No. Cases	Deaths	Percentage	Ratio
Park and Williams	1-2 days	3,406	3	0.088	1-1000
Park and Williams	3-4 days	2,541	2	0.077	1-1000
Park and Williams	5-6 days	809	1	0.124	1-800
Park and Williams	1 week	4,602	26	0.560	1-200
Park and Williams	2 weeks	961	16	1.660	1-60
Park and Williams	3 weeks	313	10	3.190	1-30
Park and Williams	Untreated	.....	...	10.00	1-10
League of Nations.	0-4 days	78,633	211	0.27	1-400
League of Nations.	5-7 days	21,972	44	0.20	1-500
League of Nations.	8-14 days	13,877	34	0.25	1-400
League of Nations.	Over 14 days	7,551	43	0.57	1-200

The severity of the bite is very important. It is well known that deep, multiple or savage bites are more dangerous than superficial ones. In 43,343 persons with deep bites, 251 died, a mortality of 0.58 per cent or 1-200. In 63,346 persons with superficial bites there were eighty-one deaths, a mortality of 0.13 per cent or 1-750, while in 13,928 persons with no visible lesion there were no deaths. (Table III.)

The intervention of clothes also is important. Of 82,538 bites on bare skin 297 died, a mortality of 0.36 per cent or 1-300. While in 29,862 bites through clothing, twenty-five died, a mortality of 0.08 per cent or 1-1200. The reason a bite on bare skin is

three times as deadly is the fact that clothes remove saliva from the dog's teeth. (Table IV.)

TABLE III
RELATION OF SEVERITY OF BITE TO MORTALITY

Type of Bite	No. Patients Treated	Deaths	Mortality	Ratio
Deep.....	43,343	251	0.58	1-200
Superficial.....	63,346	81	0.13	1-750
No visible lesion.	13,928	0	0	

TABLE IV
INTERVENTION OF CLOTHING

	No. Patients Treated	Deaths	Mortality	Ratio
On bare skin....	82,538	297	0.36	1-300
Through clothing	29,682	25	0.08	1-1200

Another point of utmost importance is the position of the bite. There were 5,943 bites on the head with 109 deaths, a 1.83 per cent mortality. On the arm 46,591 bites caused 133 deaths, a mortality of 0.3 per cent; on the trunk 4,906 bites caused six deaths, a 0.1 per cent mortality and on the leg 58,630 bites caused eighty-four deaths, a mortality of 0.1 per cent. (Table V.)

TABLE V
LOCATION OF BITE

	No. Patients Treated	Deaths	Mortality	Ratio
Head.....	5,943	109	1.83	1-50
Arm.....	46,591	133	0.29	1-300
Trunk.....	4,906	6	0.12	1-1000
Leg.....	58,630	84	0.14	1-1000

The seriousness of the head bite is pointed out by all writers and the lower mortality of trunk and leg bites is considered largely due to the fact that these bites are usually through clothing. The arm bites carry three times the mortality of trunk and leg bites. This is explained by the fact that most arm bites are on the hand which is usually uncovered. It is interesting to note that arm bites are three times as dangerous as trunk and leg bites and also bites on bare skin are three times as dangerous as bites through clothing.

Again in Table VI all cases are grouped according to the biting animal, the dog being by far the most frequent offender, although the wolf and jackal are more dangerous. This is due to the savage character of wounds made by the latter two animals.

TABLE VI
RELATION OF SPECIES OF BITING ANIMAL TO MORTALITY

Animal	No. Patients Treated	Deaths	Mortality	Ratio
Dog.....	106,907	267	0.25	1-400
Cat.....	5,531	4	0.07	1-1500
Wolf.....	1,019	83	8.15	1-15
Jackal.....	23,601	377	1.60	1-60
Solipeds.....	735	1	0.13	1-700
Ruminants.....	2,116	0	0	
Human.....	1,007	0	0	

Of interest is the observation of 1,007 bites by rabid humans without a death; also 2,116 bites by ruminants without a death.

*Rabies in Birmingham.*¹ Denison, the Director of Laboratories, and Dowling, the health officer, have done a very excellent job of preventing human rabies in Birmingham. However, they write a confusing paper and are apt to mislead the reader by their conclusions. They have mixed the figures for the city, county and state so thoroughly that it is difficult to extract those of the city alone.

Birmingham has a population of 250,000 of which 40 per cent are negroes. The dog census shows 20,000 for which ownership is established, the actual number being much higher as it is obviously impossible to count ownerless strays.

During the ten years, 1929 to 1939, a total of 1,495 animals received a positive laboratory diagnosis of rabies; 5,206 persons received antirabies vaccine and three persons died of the disease. Two of the persons dying were negroes. They say that "negroes are too unconcerned and too uninformed to suspect rabies." There is no case reported in which a person bitten by

a rabid dog was not treated. They give no figures for the relative number of white and negro persons treated in Birmingham. Yet they say that "there is little relation between mortality from rabies and the administration of antirabies vaccine, for among the highly exposed untreated (negro) population, fatalities are no greater than among the highly exposed treated (white) population and such rare fatalities as do occur are equally distributed among the treated and untreated."

TABLE VII
DEATHS FROM RABIES IN ALABAMA, 1922 TO 1936
Animals, positive diagnosis of rabies..... 9,282
Persons treated..... 34,864

Deaths	Mortality	Ratio
42	0.06	1-2000

Deaths in Treated Cases	Deaths in Untreated Cases	Total
21	21	42
White 16	14	30
Negro 5	7	12

This statement is made in the face of their figures for Birmingham which show 40 per cent negroes with twice as many deaths as the 60 per cent white population and without a single bite from a rabid animal which did not receive treatment.

On the basis of their observations they adopt a very sane regimen. They start treatment immediately for all bites above the shoulders or for multiple severe lacerations of the body or extremities and discontinue them in case the animal proves not to be rabid. In all other cases, treatment is started when the diagnosis has been established. They also cauterize the wounds with nitric acid. The purpose of their paper is to try to prevent some of the hysteria associated with dog bites and to limit treatment to actual bites or scratches made by the suspected animal.

*Rabies in Alabama.*⁸ Many of the figures which comprise the paper mentioned above concerning rabies in Birmingham¹ are taken from one entitled "Rabies in Alabama."

During the fourteen year period from 1922 to 1936 in Alabama, 9,282 animals had a positive diagnosis of rabies; 34,864 persons were given antirabies vaccine and forty-two died of the disease, a mortality of 0.06 per cent or 1-2000.

Of the forty-two fatalities, twenty-one patients had received prophylactic treatment and twenty-one had received no such treatment. Twelve deaths occurred in negroes and of these seven had received no prophylactic treatment.

In twenty-six cases the site of the bite is mentioned; it occurred on the head in eleven, on the arm in eleven, on the trunk in one and on the leg in three.

It is interesting that although their discussion deals with not treating rabies, there were only twenty-two cases reported in the series in which bites from rabid animals were not treated by the Pasteur prophylactic method and all of these twenty-two persons died of rabies. (Table iv.)

Rabies in New York City.^{*} The cost of rabies prevention to the City of New York is around \$100,000 annually.⁹ Under a charter of the State of New York, the American Society for the Prevention of Cruelty to Animals is empowered to issue licenses for dogs and cats and to collect the proceeds.⁹ During 1939 there were over 300,000 dogs licensed in New York City.¹⁰ The income to the American Society for Prevention of Cruelty to Animals was \$404,688.00.¹⁰

During the past ten years (Table viii) there have been five deaths from rabies in New York City; two of the patients received no prophylactic treatment; in one, treatment was started twenty days after the bite and in one after three days. The fifth patient received treatment after 1 day.

* Statistics quoted from Official records of the Department of Health, Bureau of P. D.

CASE REPORTS

CASE I. 1930. A child, aged twenty-eight months, was bitten under the eye by a stray dog which was never caught. The wound was carbolized by an ambulance surgeon and the mother instructed to go to the Board of Health to have the child treated. This she failed to do. Twenty-eight days later the child became quite sick and four days later was dead of rabies. Negri bodies were found. Incidentally, the child bit the nurse's finger for which bite treatment was given.

CASE II. 1934. A girl, seventeen years of age, was bitten by her own dog on the left arm. The dog died next day. The wound was cauterized and the girl's father and the girl told that they should apply for prophylactic treatment; this they failed to do. She became ill fifty-one days later and died three days after the onset of her illness. Negri bodies were found.

CASE III. 1934. A child of seven years was bitten in the face by the family dog. The wound was cauterized with nitric acid and the next day, prophylactic treatment was started. She received fifteen injections. Seven days after the last injection she became ill and died after four days of illness. Negri bodies were present in both patient and dog.

CASE IV. 1936. An infant was bitten by a rabid dog on the street. Treatment was started twenty-four hours after the dog was proved to be rabid and three days after the bite. The wound was cauterized with fuming nitric acid and the infant received twenty-one injections of the Semple treatment.

CASE V. 1938. A youth of seventeen years was bitten by his own dog which developed rabies. Treatment started twenty days after the bite. After ten injections the boy developed rabies and died in two days.

During the ten year period from 1930 to 1939 (Table viii) there have been five deaths due to rabies in New York City. There were 593 dogs pronounced rabid and 598 persons bitten by dogs so proved. Of these 598 persons bitten by rabid dogs, 586 received antirabies treatment with three deaths, a mortality of 0.5 per cent. There were fifteen persons who did not receive antirabies treatment following a bite proved to be by a rabid dog. Of these fifteen, two died, or a mortality of 13.3 per cent.

In addition there were 1,256 persons in contact with rabid dogs but not bitten by them. Of this number 826 received treatment and 430 were not treated. There were no deaths in this entire group.

In all 17,199 persons were given the Pasteur preventative treatment in New York City during the last ten years with three deaths due to rabies.

Paralysis. Paralysis occurs occasionally following prophylactic treatment of rabies and may be fatal. This complication seems to be a mild or modified type of rabies, but

that the Pasteur prophylactic treatment saves many lives by preventing rabies in persons bitten by mad dogs, but agree that it should not be administered when unnecessary.

SUMMARY

Rabies is largely of importance because of the fear and hysteria associated with it. It is perpetuated in civilized communities almost exclusively by the domestic dog. The disease is always fatal in humans. It can be prevented entirely by controlling

TABLE VIII
RABIES IN NEW YORK CITY, 1930 TO 1939*

Year	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	Total
Deaths due to human rabies	0	1	0	1	1	2	0	0	1	1	5
Number of rabid dogs (proved)	38	36	62	27	21	11	26	18	26	108	593
Persons bitten by rabid dogs (proved)	52	91	75	42	2	77	42	10	42	146	528
Persons treated after bite by rabid dog (proved)	49	92	73	41	23	73	42	10	42	144	556
Deaths		1		1		1					3
Persons not treated after bite of rabid dog (proved)	3	1	2	1		4				3	15
Deaths						1				1	2
Persons in contact with rabid dogs	321	397	278	18	34	51	37	12	40	40	1,236
Persons treated	219	248	141	37	22	34	37	11	39	38	826
Persons not treated	102	149	137	11	12	17	0	1	1	2	410
All persons given Semple treatment (including stray dogs, etc.)	2,722	2,504	1,088	1,774	1,529	1,555	1,250	1,103	1,202	1,443	17,199
Deaths		1		1		1					3

* The above statistics are from "The Official Records of the Department of Health, Bureau of Preventable Diseases."

there is doubt concerning its cause. It is suggested that it may be due to injection with the fixed virus; or possibly toxin or both. Paralysis may follow injections of nerve substances derived from a normal animal. Serious paralysis is a rare complication; in mild form it doubtless occurs more often than is indicated by the records. It affects adults chiefly, young children almost never.

Its incidence varies greatly, but is about one in 10,000 persons treated, with about one in four of these resulting fatally.

In 756,307 persons treated in the League of Nations series, 139 accidents are reported with forty-one deaths.

All students of the subject are convinced

the disease in dogs which can be accomplished by effective muzzling. Wounds should be treated by nitric acid and the Pasteur prophylactic treatment instituted at an early date. Paralysis following this treatment may occur and at times is fatal, therefore, unnecessary treatments should be avoided.

CONCLUSIONS

Wounds produced by the bite of a rabid animal or one which might be rabid should be cauterized with fuming or strong nitric acid.

Indications for prophylactic treatment are: If the dog is mad, begin treatment at once; if the dog shows symptoms of rabies,

begin treatment at once. If the dog is not mad, observe the animal closely for fourteen days and if no symptoms develop, there is no danger of the person bitten contracting rabies. If the dog cannot be identified, advise treatment except in regions known to be free of rabies. There is sufficient danger of paralysis following prophylactic treatment to make it inadvisable to administer it unnecessarily.

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MUSCLE BEHAVIOR FOLLOWING INFANTILE PARALYSIS

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THIS study of muscle behavior following infantile paralysis was undertaken to determine primarily whether it is true or not that paralyzed muscles will gain in strength if put at rest in a relaxed position. This dictum has been commonly accepted as a truth, yet our general observation over a five-year period of time has thrown considerable doubt about this in our mind.

This critical analysis of muscle grades on patients that have been treated in various ways has, therefore, served to give the desired information and has revealed other interesting and informative data.

Eighty-eight cases were used in this study. These patients had been treated in the Crippled Children Hospital for the last thirty months. Their ages varied from six months to twenty-five years. Some patients were seen early after contracting the disease, others were seen late. The type of prior treatment varied from none at all to excellent care in some other institution.

Muscle gradings on transplanted muscles were not used in this study because of the difficulty of accurately comparing the strength of the muscle in its two different positions.

Before and after gradings on muscles about a stabilized foot were not used because of the change of leverage produced in these muscles when a foot is displaced backward through the subastragaloid joint in doing the arthrodesis.

Certain muscles were not used in this study, for example, the quadratus lumborum, since it is a muscle difficult to grade accurately as other muscles may hide or overlap its action. Only those muscles that are easily graded have been used to insure greater accuracy in this study. In all the analyses except one, the only patients used

were those receiving physiotherapy and bracing, or rest and bracing, or some combination of these. The type of physiotherapy given was pool work and exercise in the gymnasium under the supervision of a graduate and well trained physiotherapist.

TABLE I

Age	9	15						
Duration before	4 Wks	6 Mo						
Duration to here	Adequate	1 Yr						
Treatment here	Pool-Brace	Pool-Brace						
Treatment before	None	None						
	D. S.	C. L.						
Name, etc								
	First Grade	Last Grade	First Grade	Last Grade				
Muscles	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt
Quadriceps	o	o	P	P	T	P	P	P
Inner hamstrings	o	o	T	T	T	T	P	P
Outer hamstrings	o	o	T	T	T	T	P	P
Gastrocnemius	o	o	T	T	o	T	o	o
Common flexors	P	o	P	o	o	o	o	o
Flex. halli	P	o	P	o	o	o	o	o
Common extensors	o	o	T	o	o	o	o	o
Ext. halli	o	o	T	o	o	o	o	o

Large charts were first made as in Table I which shows a part of one of these preliminary charts. Here was recorded the age of the patient, the duration of the disease before he came here for treatment, the type of treatment received here and the type of treatment he had received previously. The treatment here was simply classified as to whether it was considered adequate or not. Periods of physiotherapy of less than four months were not considered adequate. This, of course, does not necessarily mean that all of the physiotherapy must have been taken in the hospital, as some cases with minimal involvement may learn their exercises well enough that they may be carried out at home under the mother's

supervision after she had been taught accurately how to carry on with them. If a patient was kept here an insufficiently long period of time or if we knew that his exercises were not properly carried out at home as we had directed, his treatment was called inadequate. The type of previous treatment before coming to the hospital may have been good in some other institution or may have consisted only of the application of braces, or there may have been none at all. Such is recorded in the chart.

TABLE II

Name	No. Muscles Showing No Improvement	No. Showing Slight Improvement	No. Showing Moderate Improvement	No. Showing Excellent Improvement	No. Muscles Involved	Improvement, Per Cent
K. D.	11	1	0	16	37	62.1
V. C.	0	3	5	16	24	85.2
E. D.	0	4	5	0	18	26.4
J. H.	13	11	1	1	26	17.3

In the column below, the muscle grade was recorded when the patient first came under our observation; in the column just to the right of this was recorded the grade when the treatment was finished or when this chart was compiled. This gives then the first and last grade on the muscles that have been treated.

The muscle grading system used is as follows:

o—Trace—Poor | Fair—Good—Normal
G

The grader often used a plus or a minus after a grade if it seemed helpful or desirable, so that a muscle may grade poor plus instead of poor, thus giving a slightly more flexible range of possible grades.

An attempt was made to establish a standard method of determining the percentage of improvement made by each patient. This was worked out by considering arbitrarily that if a muscle gained more than one grade, for example, gained from

poor to fair plus or poor to good, it was considered as having made *excellent* recovery. If a muscle gained only one grade, it was considered as having made *moderate* improvement; if it made less than one grade, it was considered to be only a *slight*

TABLE III

Name	Age	Duration before Tr.	Duration Tr. Here	Tr. Here	Previous Tr.	Improvement, Per Cent
M. W. . .	13	6 mo.	Adequate	P. and Br.	Adequate	70.8
A. W. . .	2	1 mo.	Adequate	P. and Br.	None—walking	60.5
J. T. . .	4	1 yr.	Adequate	P. and Br.	None	44.7
H. H. . .	18	1 yr.	3 wks.	P.	P. and Br.	6.6
M. G. . .	3	1 yr.	2 mo.	P. and Br.	None	5.0
J. W. . .	12	4 mo.	Adequate	P. and Br.	None	48.5
K. D. . .	2	3 wks.	1 yr.	P. and Br.	None	62.1
A. D. . .	17	several yrs.	Inadequate	P. and Op.	None	21.2
E. C. . .	6	7 mo.	2 yrs.	P. and Br.	None	9.4
F. D. . .	10	7 wks.	6 mo.	P.	None	43.6

improvement; and, of course, if no improvement was found, it was graded as zero. The total number of paralyzed muscles for each patient was recorded in one column. The number showing the different degrees of improvement as determined above was recorded in appropriate columns as in Table II. From this then the percentage of improvement per case was worked out. *Excellent* was considered arbitrarily as 100 per cent improvement, *moderate* as 75 per cent improvement, and *slight* as 25 per cent improvement, and of course, zero as 0 improvement. The number of muscles in each column multiplied by the percentage of that column and all of these added together and divided by the number of muscles involved gave the average percentage of improvement that each particular patient made. Any muscle losing ground under treatment would naturally detract from these percentages but was not considered here, as so very few muscles lost ground under physiotherapy that it was considered as a negligible factor. This method of deriving the percentage of improvement is possibly subject to some question as it was empirically developed, but it seems to be as accurate as can be

obtained for this study since all cases were graded identically. It should be kept in mind that this was not a percentage im-

proved fully in carrying out their treatment. In compiling these charts on age groups, two months was considered as the

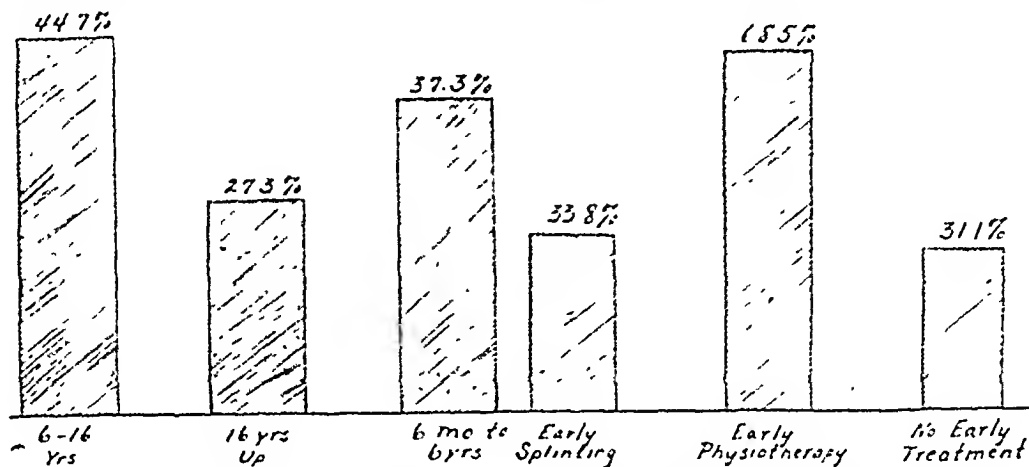


FIG. 1. Improvement by age groups.

FIG. 2. Improvement based on type of treatment.

provement in regard to the patient's ability to walk or perform other functions; it was simply a percentage improvement in the strength of the muscles he had involved. For individual muscle improvement, therefore, this does seem to be a very accurate method of measurement and estimation of the percentage of improvement.

Table III shows part of the final master chart from which all subsequent deductions and observations were compiled.

RESULTS OF ANALYSIS

The patients were first divided into three age groups: (1) Age six months to six years; (2) six years through fifteen years; (3) sixteen years up.

In the youngest age group the patient is not often co-operative in properly carrying out his exercise. The other two age groups are co-operative. The first two age groups, however, deal with growing muscles and the latter group with muscles that have ceased their normal growth. Figure 1 shows the relative degree of improvement of muscles in these three age groups. It was interesting to note that the age group six through fifteen years showed the greatest percentage of improvement. This might be expected when one considers that these patients had growing muscles and also

dividing line between long duration before treatment and short duration before treatment, and good previous treatment in these cases meant either early splinting in the proper position or early physiotherapy.

Two hundred eighty-seven muscles that graded *poor plus*, *fair*, and *good* made *excellent* improvement in 87 per cent of the cases. Two hundred seventy-six muscles that graded *0*, *trace*, and *poor* showed only *slight* or no improvement in 90 per cent of the cases. This is an interesting observation since it shows that muscles that have been paralyzed a long time and grade only *0* or *trace* or *poor* will not be benefitted by prolonged rest nor physiotherapy, while muscles grading *poor plus*, *fair*, and *good* can be expected to improve sufficiently so that physiotherapy will be justified.

Twenty-five miscellaneous patients who received adequate treatment made an average improvement of 47.5 per cent. Twenty-one patients receiving inadequate treatment made a general improvement of 20.6 per cent. This may seem to be a peculiar and perhaps worthless observation, yet it does suggest rather strongly that treatment as we know it now, in the early stages of infantile paralysis, is definitely justified.

Twenty-three suitable cases were studied to try to determine the relative efficiency of the following three plans of early treatment. (1) Early complete rest; (2) early physiotherapy; (3) no particular early treatment.

By early treatment was meant the stage from the onset of the paralysis to the disappearance of all muscle soreness.

Patients in group one were treated by having the body or involved limbs put at complete rest in a neutral position in splints, frames, or in plaster casts to give complete rest in a relaxed position to the paralyzed muscles.

Group two patients received early physiotherapy. They were brought to the hospital as soon as the acute illness and febrile stage was over. The muscles were still sore. The limbs had already been or were immediately put in proper splints and were kept in these splints at complete rest except for one interval each morning when the patient was carefully transported to the pool without muscular effort on his part. He was then given careful light massage and permitted to use, or to attempt to use his involved muscles. Extreme care was taken not to allow the patient to overdo the exercise nor to become fatigued.

Group three is composed of a small number of cases which were seen early, but these patients did not remain for treatment and they simply did about what they wanted to do at home. These were graded early and again later on so that two muscle grades were available.

In all of these cases except group three, the treatment must have been considered as adequate to be included in this table.

Group two, receiving early physiotherapy, showed 68.5 per cent improvement, group one 33.8 per cent, and group three 31.1 per cent improvement. (Fig. 2.)

It has long been thought that partially paralyzed muscles that are put at complete rest in a relaxed position will gain in strength in the large majority of cases.

This was considered as particularly true in muscles that have been under tension or

stretched by a deformed limb, for example, a partially paralyzed quadriceps femoris on a limb with a knee flexion deformity

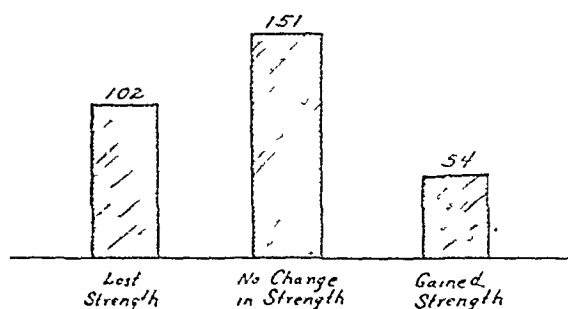


FIG. 3. Three hundred seven long paralyzed muscles treated by rest.

theoretically should gain in strength when the limb is straightened out and the quadriceps put at rest.

To check this assumption and to determine as accurately as possible the "improvement expectancy" of muscles so treated, was the primary purpose of this paper.

Three hundred seven muscles that had been paralyzed for two years or more were graded before and after being immobilized in a relaxed or neutral position.

Most of these were foot and leg muscles and most were immobilized because of an operation such as a foot stabilization, posterior capsulotomy on a knee or some other such procedure that necessitated the application of a plaster cast holding the limb in a neutral position. This period of rest varied from six to twelve weeks. Muscles that were stretched in the correction of the deformity, such as contracted hamstrings in a knee flexion deformity, were not used in this study.

This analysis showed that of the 307 muscles, 102 lost strength, 151 remained the same, and only fifty-four gained strength. (Fig. 3.)

The postoperative muscle check made immediately after the removal of the cast invariably showed a loss in muscle strength. There was a gradual regaining in their strength, however, until at the end of about three or four weeks they had reached their maximal gain, and it was this latter grading that was used in this analysis.

Further analysis of the group found that those muscles relaxed by correcting a bad deformity usually lost in strength, while those not associated with a bad deformity did not lose strength, but for the most part remained the same.

The following example will clarify and illustrate more explicitly the previous statement:

A patient having a calcaneus foot had four common toe flexors that graded good or normal in strength. The foot was operated upon and put up in a position of equinus for six weeks. The operation was a transplantation of the tibialis anterior to the heel cord and the toe flexors were not damaged or even touched during the operation. After removal of the plaster cast, they graded only trace and did not subsequently regain that strength. When this foot was forcefully pushed upward into dorsiflexion, the four toe flexors then contracted powerfully. This seemed to demonstrate that the muscle belly of the toe flexors had not lost strength itself, but that its tendon was so relaxed by the new position of the foot that when contraction of the muscle occurred, it simply took up the slack and was not able, therefore, to produce a pull at the point of insertion. The muscle had accommodated itself to the calcaneus position where the toe flexor tendons ran down and around the medial malleolus and then back up to the toes. When the foot was placed in equinus, the distance between tendon origin and insertion was considerably shortened, leaving a slack tendon. Proper intrinsic muscle strength also depends on some constant "contraction tonus" in a muscle. This "tonus" was lost by relaxing the muscle in correcting the deformity, so that it actually graded much weaker than it formerly did. The contraction that did occur in this muscle belly was shorter in range and was ineffectual because it simply was only enough to take up the slack that existed in the new position. Simple disuse atrophy that occurred during the period of immobilization was likewise a factor that may be considered in explaining some of the loss in muscle strength.

The foregoing analysis has definitely shown that long paralyzed muscles put at

complete rest in a relaxed position lost strength more often than they gained strength; hence, it was impossible to work out an accurate percentage estimate of expected improvement in these muscles following such handling.

A general comparison of the muscle groups involved in the original charts showed that leg muscles were more often paralyzed than arm or trunk muscles. Trunk muscles were more often involved than arm muscles. In the upper extremity the maximal involvement was most frequently in the deltoid shoulder group of muscles. In the lower extremity the foot and leg muscles more frequently showed the most severe paralysis. Foot and hip flexor deformities were the most common deformities of infantile paralysis. The tibialis anterior was the most common single muscle involved. The tibialis posterior was involved more often than the peroneal group of muscles. The knee extensors were more often involved than knee flexors. The opponens pollicis was the most frequently paralyzed intrinsic muscle of the hand.

SUMMARY

1. Muscles long paralyzed that were treated by rest in a relaxed position for six to twelve weeks lost strength much more often than they gained.
2. Muscles that graded *zero*, *trace*, and *poor* and had been paralyzed as long as three months showed no appreciable gain on physiotherapy treatment.
3. Muscles that graded *poor plus*, *fair*, and *good* showed a considerable and justifiable improvement with physiotherapy.
4. The age group six to sixteen years showed a greater improvement than younger or older groups.
5. Patients who received early careful physiotherapy showed much better muscle recovery than those treated otherwise.

OSTEOPLASTIC CRANIOTOMY

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THE methods usually employed in the cutting of large osteoplastic flaps in the skull have many disadvantages which to permit of their use, head rests capable of supporting the head firmly have been designed.



FIG. 1.



FIG. 2.



FIG. 3.

FIGS. 1, 2 AND 3. Showing how the head is supported in the specially prepared head rest. Note the arrangement of the patient's trunk and left arm. The photographs were taken a week after the removal of an astrocytoma in the right occipital lobe.



FIG. 4.

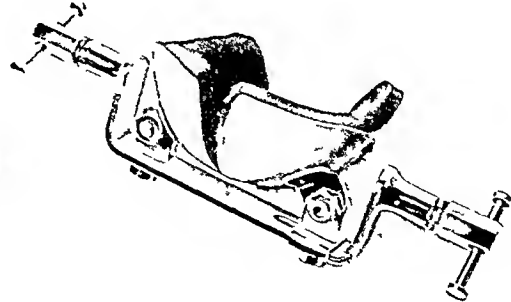


FIG. 5.

FIGS. 4 AND 5. An adjustable head rest, used to support the head in exploring the cerebellar fossa and sometimes when cutting occipital and frontal osteoplastic flaps.

need not be discussed. The procedure to be described has been developed by the author and thoroughly tried out during the last ten years. It is based on the work of Souttar, but has certain advantages of its own and avoids some of the disadvantages inherent in Souttar's method. Special tools are used in dividing the bone, and in order

HEAD RESTS

Unless the head is fixed efficiently, the craniotome cannot be used. The author's head rest consists essentially of a reinforced plaster of Paris facing, made after the manner of splints previously described by the author.¹ It is made, prior to operation,

on the patient's head and neck, in such a way that the field of operation is not encroached upon. The plaster facing is

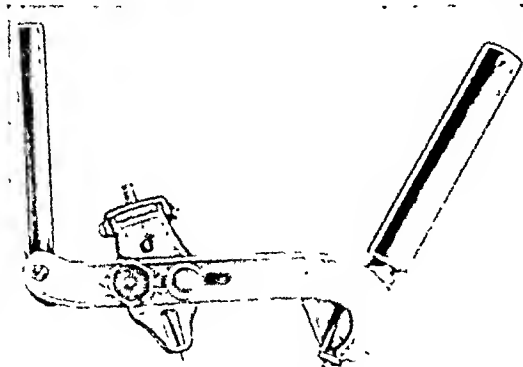


FIG. 6. The craniotome.

above, no head rest known to the author provides fixation sufficient to permit the use of the craniotome described below.

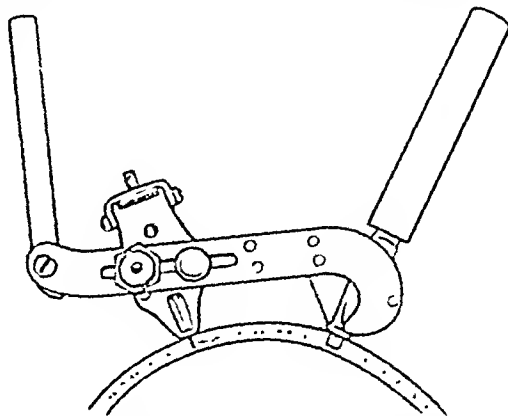


FIG. 7. Diagrammatic representation of the craniotome in position on the skull. The pin is carried in a hole in the bone, which is bored by the drill shown in Figure 9. The cutting tool has almost penetrated the bone, the remainder of which is broken in elevating the flap.

affixed by means of plaster cream to a metal ring, which in turn is carried on an adjustable attachment on the operating table. Universal movement is thus provided. The facing may be made in about ten minutes and saves a great deal of time at operation. (Figs. 1, 2 and 3.)

The rest as depicted in Figures 1, 2 and 3 permits the cutting of temporoparietal flaps. When it is desired to operate in the frontal or occipital regions, the plaster facing is made accordingly so as to leave the area in question free, and the patient lies either prone or on his back, as may be required. Sometimes, however, during the cutting of frontal or occipital flaps, an adjustable head rest is used which affords adequate though less efficient fixation. (Figs. 4 and 5.) The facing of the adjustable head rest is of spongy rubber, carried on two aluminium plates beaten to such a shape that they may be applied more or less closely to the great majority of heads or faces. By slackening off various nuts the plates are rendered movable and are applied snugly to the appropriate area of the patient's skull. The nuts are then tightened and the adjusted rest is placed in position in the mechanism of the operating table which provides all necessary movements. This head rest was designed in the first place to support the head during operations upon the cerebellum and is very efficient in this regard. Other than those described

THE CRANIOTOME

The craniotome is operated by hand. (Figs. 6 and 7.) The pin around which the cutting tool swings is situated at the end of a heavy handle. An arm which carries the cutting tool is swung from the pin in such a way that the center of movement is just below the surface of the skull when the pin is placed in a hole drilled for its reception. (Fig. 7.) Thus if during operations the pin handle wobbles slightly in relation to the skull, the cutting tool does not vary in its track round the pin. The cutting tool is carried in a heavy metal block which may be moved along the carrying arm so that the surgeon may vary the distance from the pin to the tool. The angle which the block makes with the arm is also adjustable. The cutting tool is moved up or down in the block by turning a threaded collar through which the tool passes; thus the surgeon is able gradually to deepen the incision to any required extent.

The cutting tool is made from a piece of tool steel rod, one-quarter of an inch in diameter. At its upper end it is threaded and carries the adjusting collar already mentioned. At its lower end it is ground

so as to leave a flat section about three sixty-fourths of an inch thick and one-quarter inch wide. The end is ground

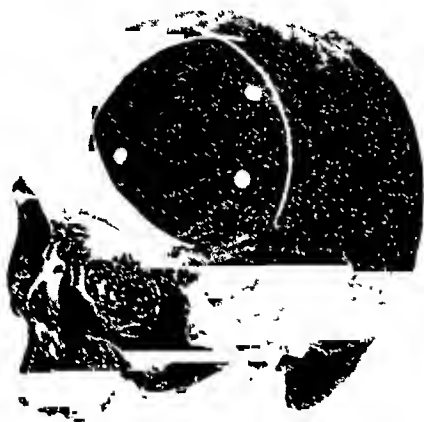


FIG. 8. Flap outline on a skull. By using three centers, flaps of any desirable shape and size may be cut. The lateral incisions pass over the temporal crest into the temporal fossa. The base of the flap, which is comparatively narrow, is broken through in elevating the bone.

much in the shape of a Hutchinson's incisor tooth. The flattened part of the tool slides through a slot in the nose of the carrying block, so that rotation is prevented. The tool cuts in either a clock-wise or an anti-clock-wise direction around the central pin.

METHOD OF USE

The instrument is used to cut arcs of a circle round the central pin. In practice the radius of the circle is set at about two and one-half inches. It is hardly ever desirable to make a full circular incision. By the use of three centers, flaps of any desired size and shape may be cut. An example is shown in Figure 8. In all cases the scalp is peeled from the skull in the selected area and the ends of the bone incision pass just below the temporal crest. The bone at the base of the flap is broken across beneath the temporal muscle when the flap is elevated. The flap remains attached to the muscle.

TECHNIC

The patient is anesthetized and then placed in position on the operating table. The head rest is adjusted and the body of

the patient is fixed so that it cannot move. This is very important, and a good deal of apparatus has been designed to ensure

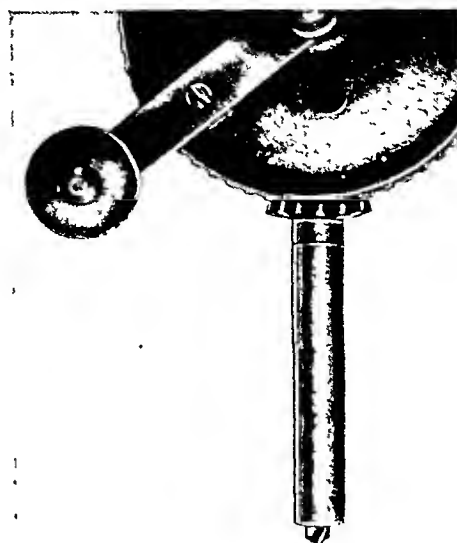


FIG. 9. Drill used to bore holes in the skull for the reception of the pin of the craniotome. The tube guard prevents the drill from entering too deeply and may be slipped off for cleansing purposes.

proper fixation. The scalp is shaved and prepared *secundum artem*. The line of the incision is scratched on the scalp and should be about one-half inch outside the line of the proposed bone incision in the skull. The scalp is incised and reflected. Hemostasis is carefully effected. With a pair of dividers, the points of which are about two and one-half inches apart, three (usually) centers for the proposed arc incisions in the skull are quickly located and marked on the bone surface with a pointed steel instrument. An engineer's morse drill, of the same diameter as the pin of the craniotome and provided with a guard which prevents it from entering more than one-quarter inch below the outer surface of the skull, is used to bore holes for the reception of the pin of the craniotome at the selected spots. (Fig. 9.) The boring of a hole is the work of but a few seconds. In the boring of many hundreds of holes the dura has never been damaged by this drill. The pin of the craniotome is placed in one of the holes. The cutting tool is set so as to project about one-sixteenth inch.

Assistants steady the head in the head rest. The surgeon with one hand sweeps the tool round the pin, which he steadies with the other hand. The tool is progressively adjusted so as to cut deeper and deeper. The approximate thickness of the skull is known from the appearance of the skiagraphs. The bottom of the incision can be clearly seen throughout the operation if a head light is used. When dark spots begin to appear, a probe is used to ascertain whether the bone has been penetrated in places. If so, the incision is deep enough. The remaining arcs are then cut. Four specially curved levers, similar to those used by Souttar, are then inserted into the incisions and the bone flap is elevated and turned back on the temporal muscle, which is attached near its base. More bone may be nibbled away in the temporal fossa if desired. Further procedures are undertaken in the usual way.

ADVANTAGES OF THE METHOD

The effort required to cut bone flaps of any size is not great. Unless unusual difficulties are encountered, such as excessive vascularity of the scalp, the dura may be exposed in from fifteen to twenty minutes from the time of commencement of the skin incision without any show of haste and with no neglect of hemostasis. If diploic vessels are cut across, bleeding is promptly, easily and safely checked by means of wax forced into the incision. The dura mater is not disturbed until the bone is elevated and the surgeon is in a position to control hemorrhage from its surface. The risk of wounding the dura or its vessels by the passage of guides beneath the skull is thus eliminated. The flap is neat and shapely, and when replaced is in firm bony contact with the edges of the defect in the skull. Bony union follows. Variations in thickness and texture of the bone of the skull make but little difference to the progress of the operation.

The craniotome is sturdily built and almost everlasting. It needs no attention beyond ordinary cleansing and perhaps

sharpening of the cutting tool edges after cutting some dozens of bone flaps.

DISADVANTAGES OF THE METHOD

A special facing for the head rest is necessary for every case. This entails about ten minutes' skilful work before operation, but it is time well spent. Naturally, the plaster must be made correctly. Carelessness or clumsiness on the part of the surgeon in cutting too deeply might result in laceration of the dura mater and the brain. Such an accident could not occur unless the tool projected through the bone at least one-sixteenth inch, as the dura always gives way to some extent. As the bottom of the incision is visible for a moment at least after each sweep of the craniotome, penetration, which always occurs first at a few isolated points, should be noted long before the danger point is reached. It is confirmed by careful probing. The craniotome has been used exclusively in cutting about one hundred fifty bone flaps, and the dura mater has been slightly punctured in but two of the earlier cases. On the other hand, there is no doubt that in the hands of a clumsy or unskilful operator, damage might be done; but in such hands no method is safe.

SUMMARY

It is pointed out that the usual methods of cutting large osteoplastic flaps in the vault of the skull have serious disadvantages, many of which are avoided by the use of the method described.

Special tools for cutting the bone are described, as well as head rests which provide for efficient fixation of the head during operation.

The technic for using the apparatus is described.

Finally, the advantages and disadvantages of the method are discussed.

REFERENCE

1. H. C. TRUMBLE. Made to order splints. The technique of construction and field of application. *Brit. J. Surg.*, 19: 292, 1931.

COLOR ILLUSTRATIONS

COLOR ILLUSTRATIONS

IN May we announced that from time to time we would present pictures of merit in color. Through the courtesy and generosity of Ciba Pharmaceutical Products, Inc., of Summit, New Jersey, who have supplied these illustrations, we are pleased to present to our readers a group of color plates portraying the major pathological conditions of the testicle and prostate.

The drawings were made by Dr. Frank Netter, the well known anatomical artist, and the copy was prepared by Dr. Samuel A. Vest, of the Department of Urology, University of Virginia Hospital.

We believe that these colored illustrations are particularly attractive and will aid in supplementing textbook descriptions of the normal prostate, benign prostatic hypertrophy, carcinoma of the prostate and malignant tumors of the testicle, and thus clear up any confusion which might exist in the minds of our readers regarding these pathological disorders.

T. S. W.

COLOR ILLUSTRATIONS

PROSTATE AND TESTICLE

PORTRAYAL IN COLOR OF THE NORMAL PROSTATE AND
PROSTATIC AND TESTICULAR DISORDERS

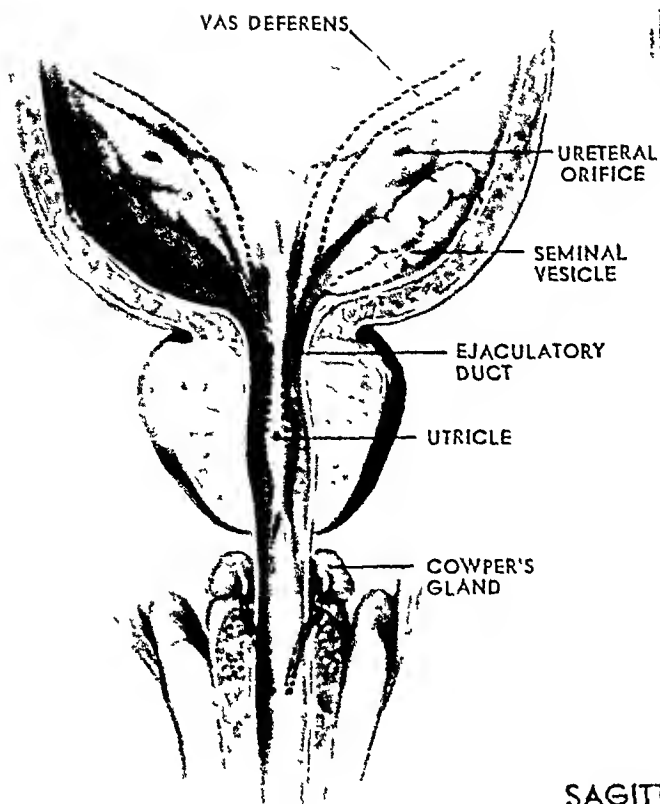
THE NORMAL PROSTATE

BENIGN PROSTATIC HYPERTROPHY

CARCINOMA OF PROSTATE

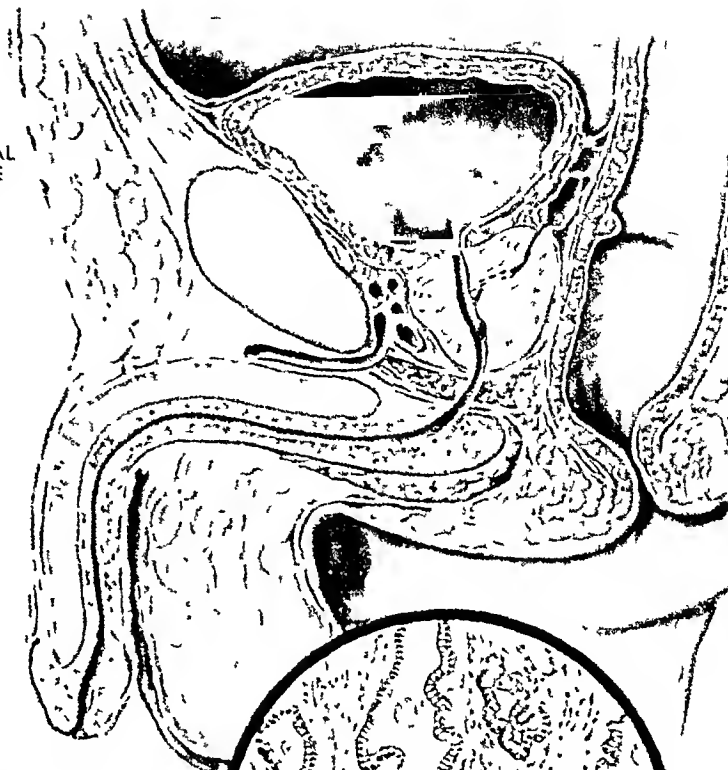
MALIGNANT TUMORS OF THE TESTICLE

THE NORMAL PROSTATE

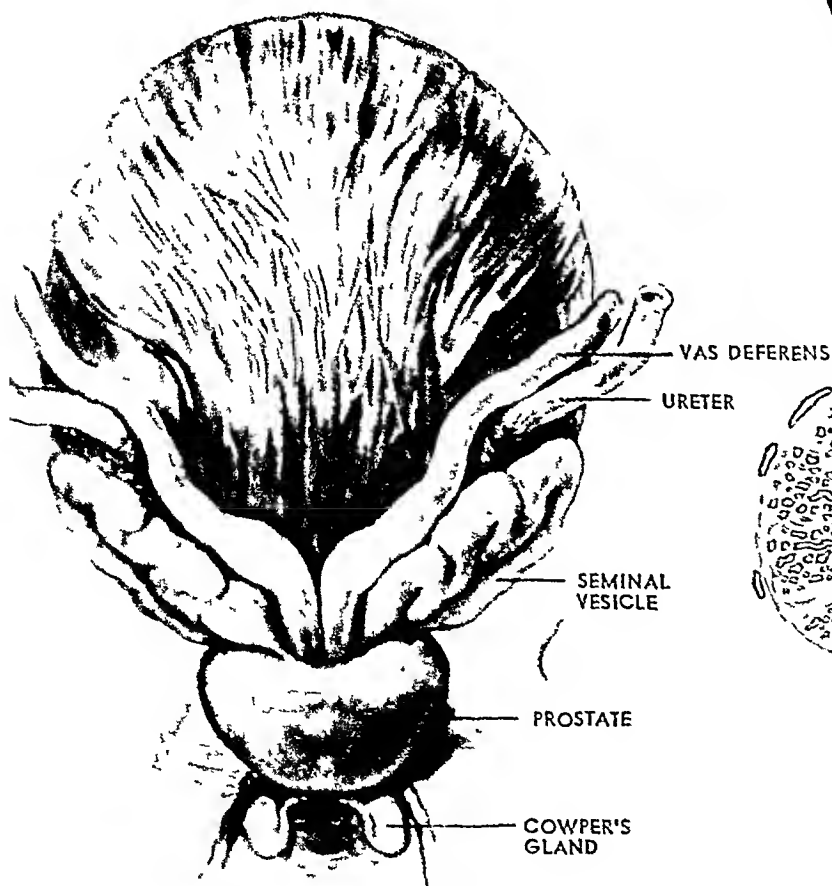


FRONTAL SECTION

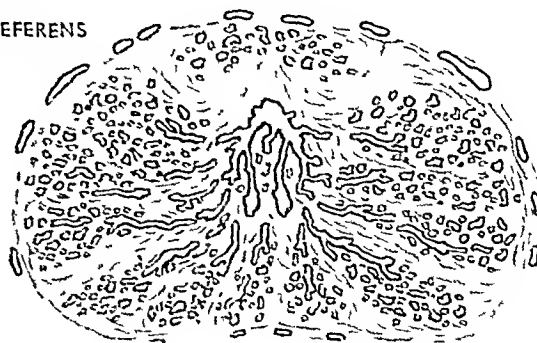
SAGITTAL SECTION



HISTOLOGY



POSTERIOR VIEW



CROSS SECTION

THE PROSTATE

THE PROSTATE is the most important of the accessory sex glands. It is of particular clinical significance because of the frequency with which it becomes infected, hyperplastic and malignant. Because of the prostate's strategic location surrounding the posterior urethra and the vesical orifice, disease of this gland produces obstructive symptoms varying from the insidious and obscure to the most dramatic. The prostate develops as epithelial offshoots from the embryonic posterior urethra and is the homologue of the suburethral glands in the female, which, under certain conditions, grow to form a "female prostate." Until the age of puberty the prostate is impalpable and consists of a thin layer of immature glands around the urethra. The anatomical development and maintenance of secretory function depend upon a continuous, adequate supply of male hormone from the interstitial cells of the testicle. Castration results in subsidence of secretory activity and atrophy. In young men the gland weighs 20-odd grams with gradual involution and atrophy later in life except in instances when hyperplasia occurs.

This gland is composed of alveoli lined with columnar epithelium embedded in a relatively thick fibro-muscular stroma. They are drained by a system of branching ducts or tubules which empty into the posterior urethra. The complexity of the internal structure renders drainage difficult once infection has taken place.

The prostate is a gland of external secretion. The fluid is ejected by contraction of the smooth musculature within the prostate at the climax of the sexual act. The normal secretion consists of milky fluid containing lipoid granules, corpora amylacea, epithelial cells and spermine crystals. This alkaline secretion is believed to provide a medium concerned with the maintenance and activation of spermatozoa after ejaculation. There is evidence that the prostate's secretory activity can be stimulated or depressed by various drugs and hormones. The prostate also functions in an excretory capacity and excretes numerous substances such as alcohol, sulfanilamide, and other drugs in minute amounts.



BENIGN PROSTATIC HYPERTROPHY

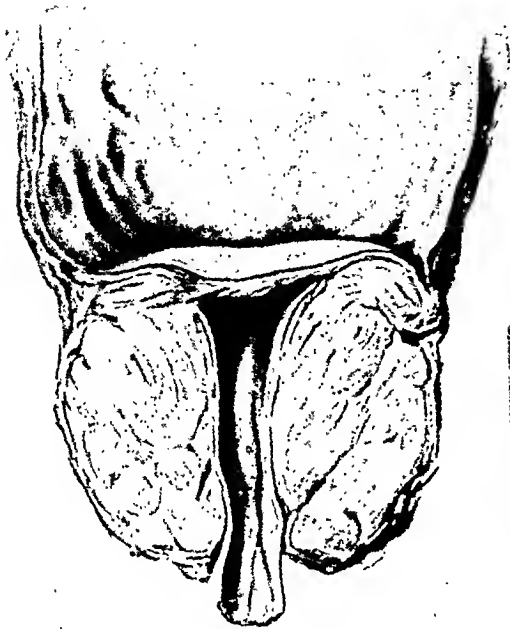
BENIGN PROSTATIC HYPERTROPHY is of considerable general interest not only because of its local effects but because of the widespread systemic changes which sometimes result. There has been much speculation as to the nature of the enlargement, whether it is an actual tumor such as adenoma, fibro-adenoma, fibro-myoma, etc., and whether it is a result of inheritance, arteriosclerosis, infection, sexual activity, hormone imbalance, etc. The etiology is still obscure but has been the object of much endocrinological investigation during the past decade. The disease is primarily one of senescence occurring in approximately one-third of all males over 60 years of age. It has been said that some oriental races are not afflicted with this malady. Normal prostatic development and function depend upon the secretion of the male hormone from the interstitial cells of the testicles. The presence of functioning testicles is also necessary for the development of prostatic hyperplasia and no cases have been noted in eunuchs. Once the hyperplasia has developed there is little evidence that it is affected by castration. There is evidence that the secretion of male hormone (androgen) is decreased in old age. Female hormone (estrogen) has been found in the urine of normal men. This has led to a theory that the decrease of androgen in old age results in a preponderance of estrogen and that this imbalance is the cause of prostatic hypertrophy. Disturbances in the hormone secretion of other glands, especially the pituitary and adrenal, have been also considered as theoretical etiological factors.

Benign prostatic hypertrophy affects certain areas within the prostate and is not a diffuse hyperplasia of the entire organ. The portion which becomes hypertrophied most frequently is that adjacent to the urethra. The enlargement of these peri-urethral or submucous glands compresses the remaining normal or atrophic prostatic acini into a thin rim of tissue which is designated as the "false capsule." Several types of gross enlargement are usually encountered. Of these, the most frequent are: (1) bilobular (two lateral lobes), (2) trilobular (two laterals with median), (3) unilobular (median), and (4) circular or confluent enlargement at the vesical orifice. In lateral lobe hypertrophy the lobes are frequently joined at the internal vesical orifice by a posterior commissure. In median hypertrophy the lobe pushes its way into the bladder, while in the lateral type there is great elongation of the urethra before the lobes project into the bladder. The configuration of the lobes is readily recognized by cystoscopic visualization.

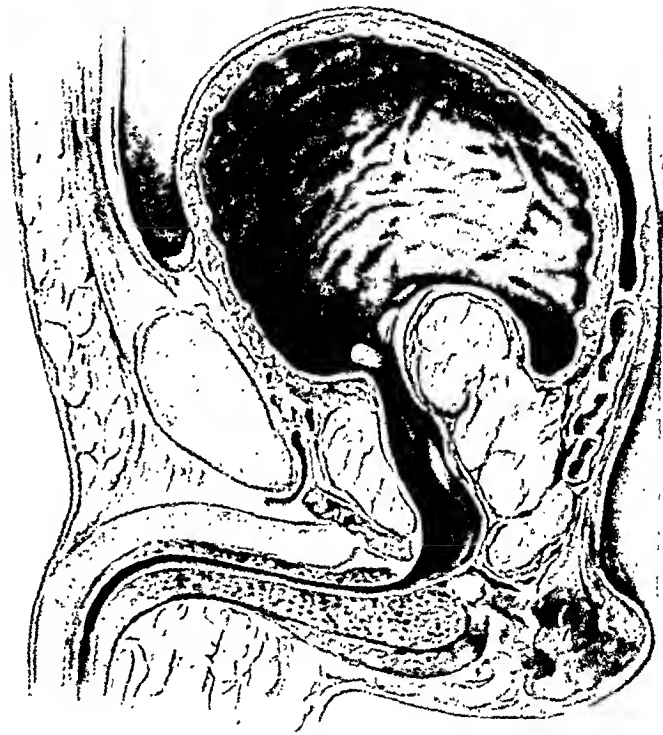
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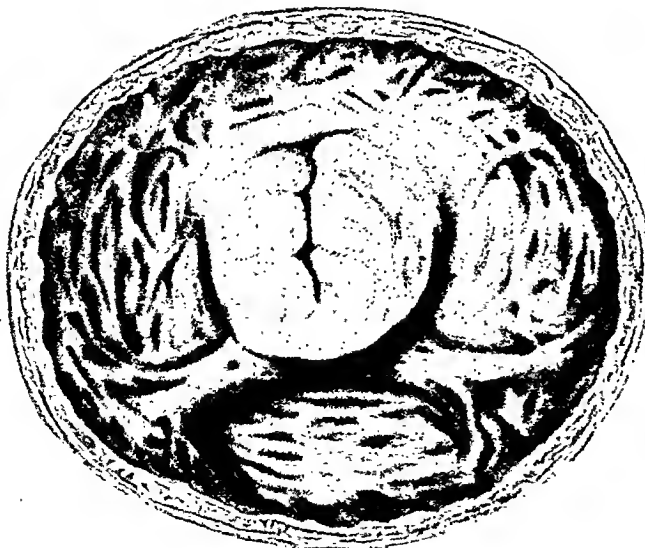
BENIGN PROSTATIC HYPERTROPHY



LATERAL LOBES
WITH MEDIAN
COMMISSURE



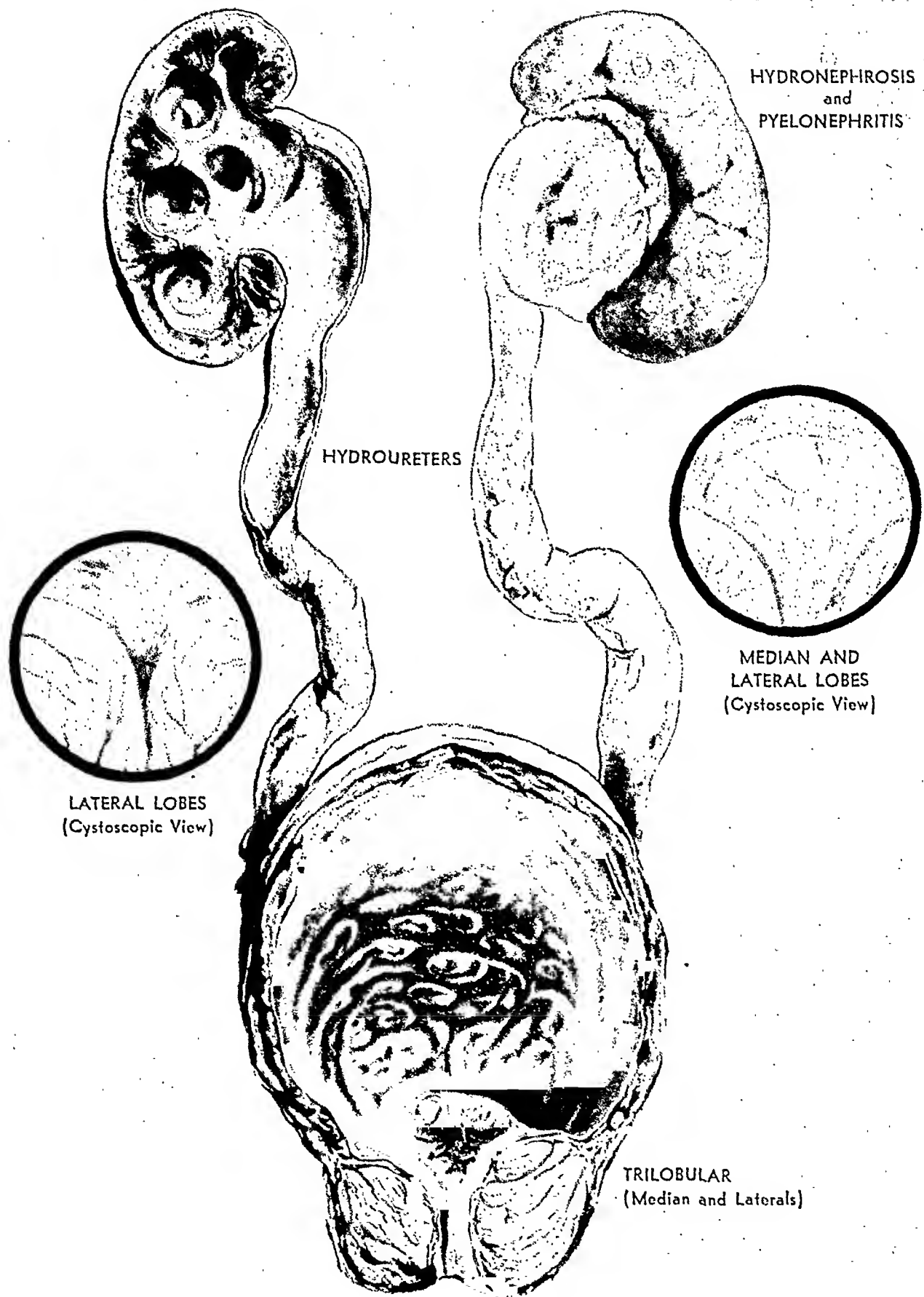
MEDIAN LOBE



LATERAL LOBES
WITH MEDIAN
COMMISSURE
[Intravesical View]

J. Netter, M.D.

BENIGN PROSTATIC HYPERTROPHY



BENIGN PROSTATIC HYPERTROPHY

(Continued)

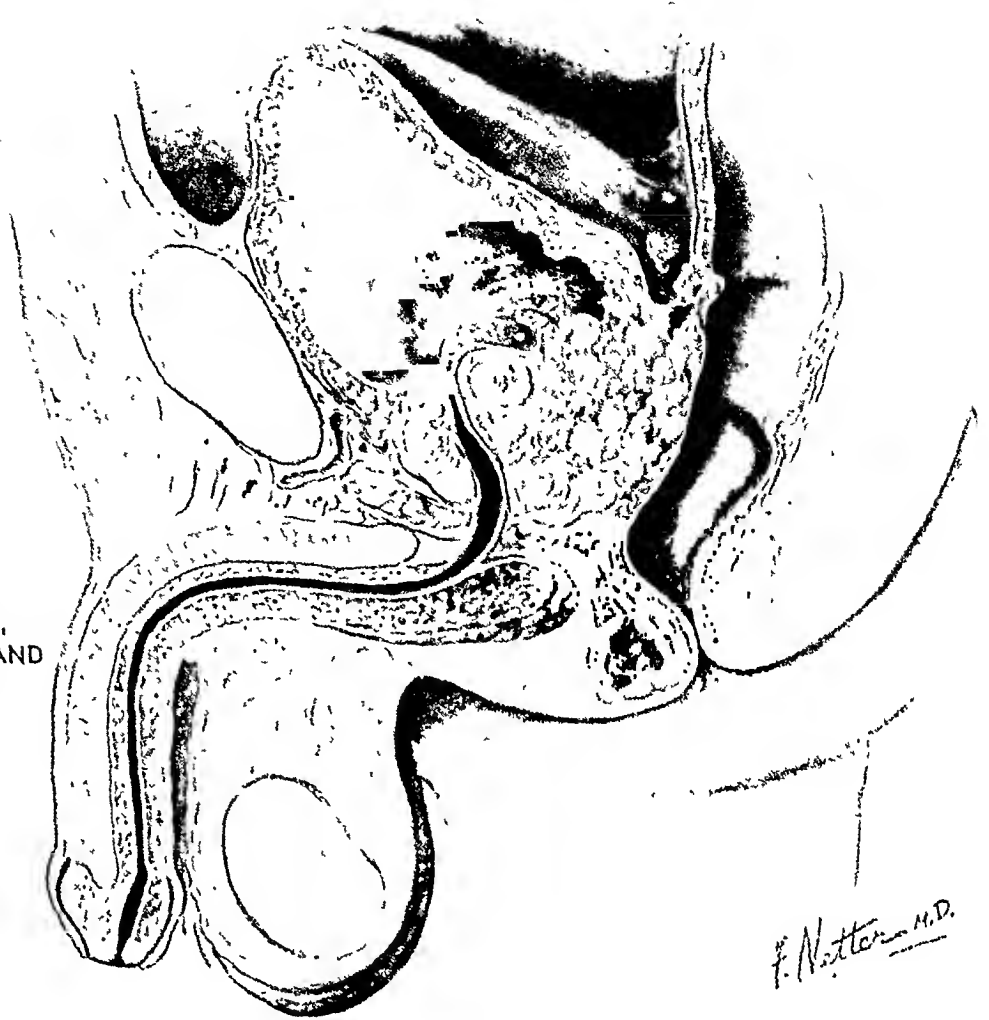
Such hypertrophied masses obstruct the posterior urethra and vesical orifice, seriously interfering with urination. This obstruction results in profound changes in the bladder, ureters, and kidney. Voiding requires increased pressure which leads to hypertrophy and thickening of the bladder wall. Trabeculation and cellules are common, and even large sized diverticula may be formed. The bladder finally reaches the limit of compensatory hypertrophy, after which there is gradual decompensation and dilatation with the development of residual urine. Rapid decompensation results in acute dilatation with complete urinary retention.

The most serious complication of prostatic hypertrophy is progression of the obstruction to the point where the back pressure is transmitted to the ureters and kidneys, producing hydroureter and hydronephrosis. If the obstruction is not relieved there is progressive decrease in renal function, resulting in uremia and death. The bladder may become secondarily infected following catheterization. This is often of grave significance, as it may lead to infection of the upper urinary tract. Acute pyelonephritis often precipitates fatal uremia, especially when hydronephrosis has already lowered the reserve function of the kidneys. Impaired kidney function complicated by acute retention and pyelonephritis is responsible for a considerable portion of the mortality in this disease. The mortality is low if the early symptoms are recognized and necessary treatment instituted before the onset of complications. It should be stressed that marked obstructive changes in the bladder, ureters and kidneys can occur with relatively mild symptoms.

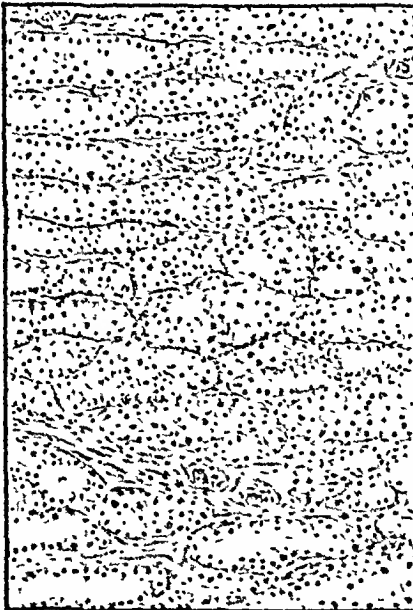


CARCINOMA OF PROSTATE

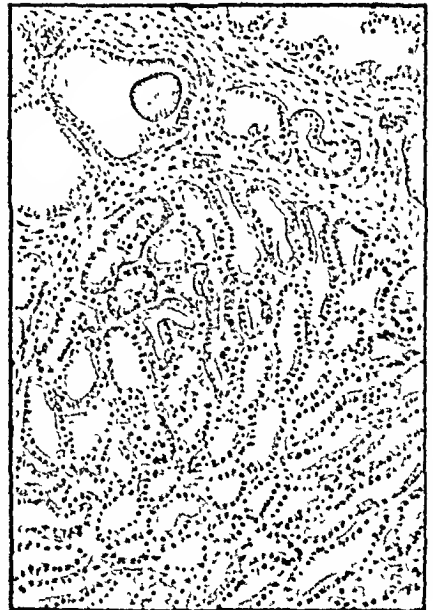
EXTENSION OF
CARCINOMA
INTO BLADDER,
PERITONEUM AND
RECTAL WALL



SCIRRHUS



MEDULLARY



CARCINOMA AND
BENIGN HYPERPLASIA

CARCINOMA OF PROSTATE

CARCINOMA OF THE PROSTATE is present in about 25 per cent of all men who reach the age of 60, but because of its usual slow growth a majority of the victims do not die of the disease itself. Three clinicopathological forms of prostatic carcinoma are recognized. First, the tiny occult carcinoma, which is symptomless except in rare instances when it metastasizes; second, carcinoma occurring together with benign hypertrophy; third, carcinoma unmixed with benign hypertrophy in which a variable portion of the prostate has become infiltrated. There is considerable variation in the microscopic findings in prostatic carcinoma but they usually reveal adenocarcinoma growing irregularly in abundant fibrous stroma. This scirrhous form results in the stony hard gland felt on rectal examination. Occasionally, the fibrous stroma is less plentiful, as in the medullary variety, which is soft on rectal palpation, rendering diagnosis difficult. Carcinoma of the prostate usually infiltrates the posterior aspect of the gland. In advanced cases there is an invasion of the posterior urethra, triangular ligament, seminal vesicles and at times extension into the bladder, peritoneum and rectum. The tumor frequently grows into the pelvis by way of the lymphatics and nerve sheaths. Extension to the pelvic bones and lumbar vertebrae is common.

The lack of symptoms in the early stages of the disease is striking, and metastases to bone sometimes produce the first symptoms. Obstructive symptoms are late manifestations and there is evidence that over 50 per cent of cases have metastases by that time.

The usual course of carcinoma of the prostate is slow and insidious, but rapid growth and widespread metastases are not infrequent. The hope of cure lies in early recognition before obstructive and metastatic symptoms develop. It should be diagnosed in the early stages while it is still a localized, hard nodule confined within the prostatic capsule. Routine, careful rectal examination in all men over 50 years of age is important and any suspicious induration discovered should be subjected to expert opinion.



MALIGNANT TUMORS OF THE TESTICLE

TESTICULAR NEOPLASMS form a very interesting group of tumors because of their cytological relationship to the primitive sex cells. Approximately 1 out of every 200 malignant tumors in the male originates in the testicle. It is essentially a disease of young adulthood with the maximum frequency of cases occurring between the ages of 20 and 40 years. It has been estimated that malignant tumors occur two hundred times more frequently in undescended testicles. Trauma and chronic irritation are thought to stimulate growth in a dormant tumor in many cases. The exact cellular origin of testicular tumors is still obscure. This has led to much controversy concerning the many pathological classifications. For present purposes the tumors are grouped according to their histologic appearance without reference to their complex genesis. Testicular tumors are almost all potentially malignant and benign tumors such as lipoma, fibroma, myoma and angioma occur so infrequently that they need not be considered. Tumors of the interstitial cells and adrenal rests which have been known to produce virilism in young boys are a great rarity. Malignant testicular tumors fall into two general pathological groups, the unicellular and the multicellular. Some authorities believe that the unicellular tumor is initially a multicellular tumor in which a great overgrowth of one cell type has taken place.

UNICELLULAR TUMORS are practically all epithelial and commonly known as seminoma, spermatocytoma, round cell sarcoma, etc., by various writers. They are homogeneous, lobulated, tumors of yellow-orange color. The cells are polygonal, have large nuclei, and may resemble spermatocytes. They vary in degree of malignancy, but in general grow somewhat more slowly and metastasize later than other malignant tumors. They metastasize through both lymphatics and veins.

MULTICELLULAR TUMORS are commonly known as teratomata, or mixed tumors. They are characterized by the presence of tissues derived from the three primary germ layers. Many types of tissue may be found in such mixed tumors, and the character of a given tumor is often determined by the overgrowth of tissue from any one of the three germ layers. For example, a tumor might be almost completely epithelial and even appear homogeneous. Four types of multicellular or teratomatous tumors are usually encountered.

Adult teratoma is relatively rare and makes up only 5 to 10 per cent of the multicellular group. It contains a predominance of adult tissue such as hair follicles, cartilage, bone, muscle, etc. There is a great variation in the gross appearance of the tumor but cystic structures are consistently present. It is the least malignant of the multicellular group and metastasis is a late development.

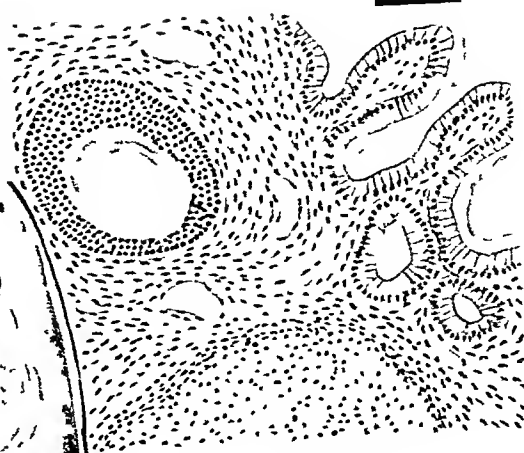
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MALIGNANT TUMORS OF THE TESTICLE



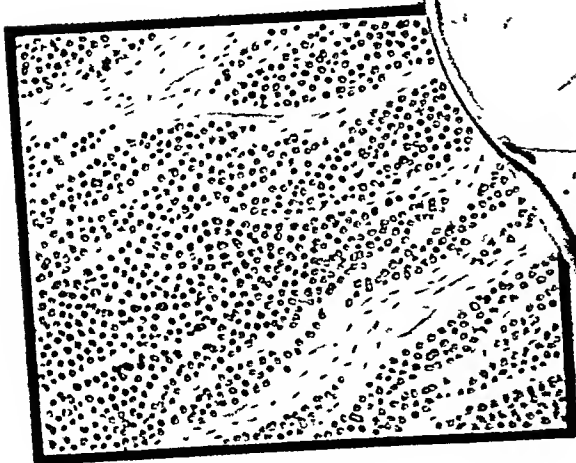
ADULT TERATOMA



ADULT TERATOMA

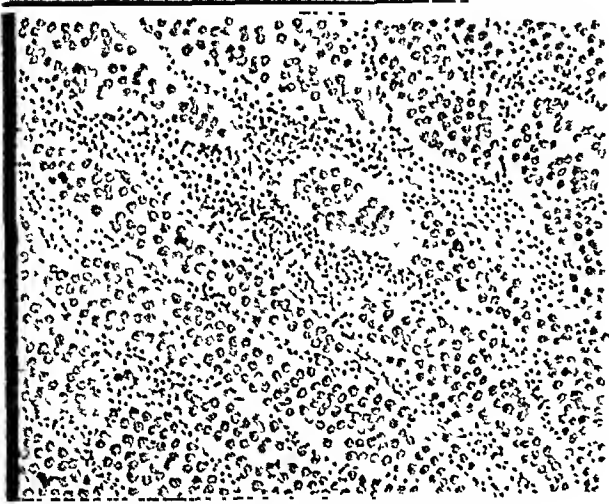


UNICELLULAR TUMOR
(Seminoma)

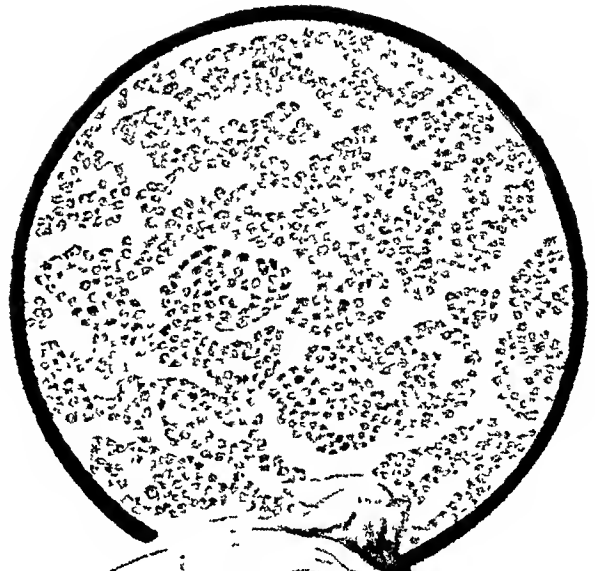


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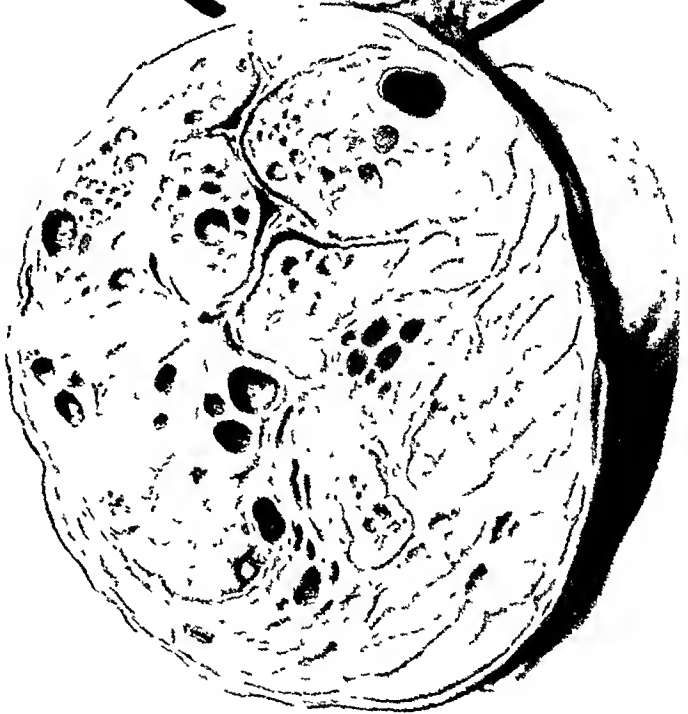
MALIGNANT TUMORS OF THE TESTICLE



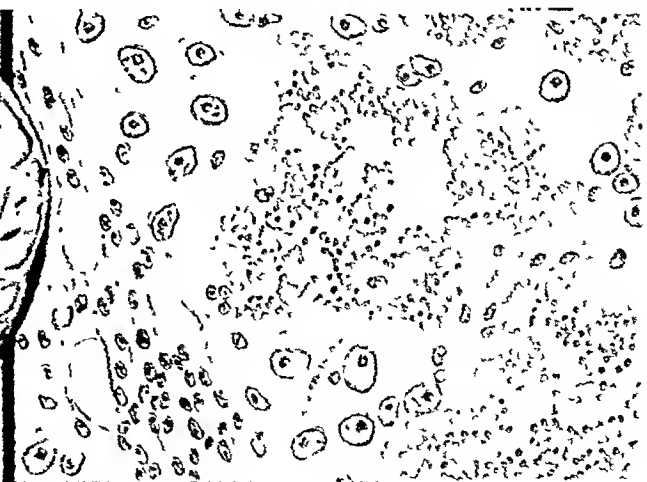
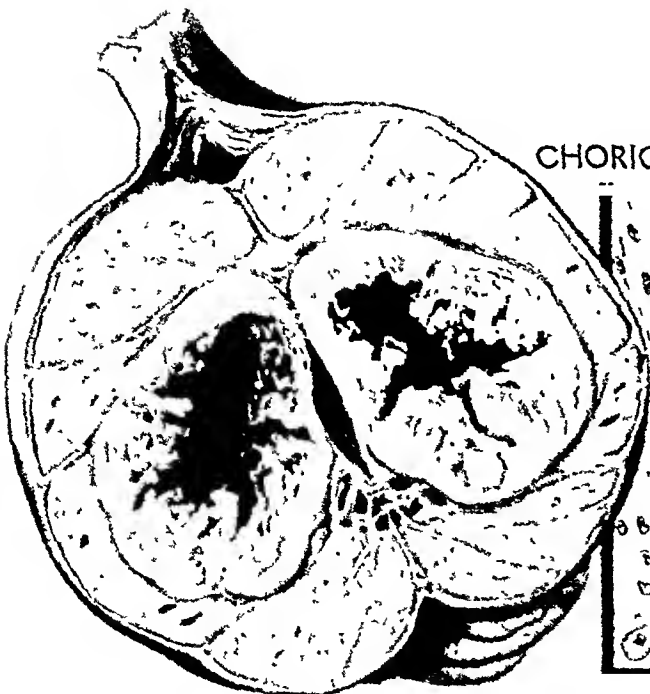
EMBRYONAL CARCINOMA
WITH LYMPHOID STROMA



EMBRYONAL
ADENOCARCINOMA
(Microscopic section
in circle)



CHORIONEPITHELIOMA



MALIGNANT TUMORS OF THE TESTICLE

(Continued)

Embryonal adenocarcinoma occurs far more frequently than adult teratoma. The gross appearance may be somewhat homogeneous due to considerable overgrowth of the epithelial elements, but more often it is nodular and cystic with areas of degeneration. Histologically there is a predominance of malignant embryonic epithelium. Islands of other tissue with varying degrees of differentiation may be found.

Embryonal carcinoma with lymphoid stroma is another type of teratoma in which there is an abundance of lymphoid tissue present along with the embryonal carcinoma cells.

Chorionepithelioma is a very interesting and highly malignant teratoma. It more often occurs as a small mass within a normal testicle but it may be part of a sizable tumor containing other types of tissue. Hemorrhage into the tumor is characteristic. The histologic elements are syncytial and Langhans' cells which surround blood spaces. This structure is similar to that seen in the chorionic villi of the fetal membranes and in chorionepithelioma in the female. Metastases are usually hematogenous, rapid and widespread. Enlargement of the breasts sometimes occurs.

* * *

Any firm, painless mass involving the testicle, whether smooth or lobulated, should be considered malignant until proven otherwise. The presence of gonadotropic hormone in the urine in many cases is of considerable diagnostic and prognostic value. This hormone in the urine is believed to indicate that the tumor has cells of primitive nature and is likely to be susceptible to radiation therapy. The persistence, or reappearance of gonadotropic hormone in the urine after orchidectomy, signifies the presence of metastases. An early diagnosis followed by orchidectomy and irradiation offers the best chance for cure.



Case Reports

DIAPHYSEAL TUBERCULOSIS

REPORT OF A CASE WITH RAPID DESTRUCTION AND SPONTANEOUS PATHOLOGIC FRACTURE

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TUBERCULOSIS of the shaft of a long bone is usually a slow, progressively destructive disease similar to that found in the metaphysis. Instances have been reported in which the disease has run a subacute^{1,2} or even an acute course.^{3,4} The following case is of interest because massive destructive of the ulnar shaft, complicated by a spontaneous pathologic fracture, occurred within four weeks after the onset of the first clinical symptoms.

CASE REPORT*

The patient was a white male, age thirty-four, of Greek nationality. The skeletal system was first involved in 1922 at which time he experienced pain and swelling of the right wrist. Although the diagnosis was apparently not clear at this time, according to the patient, an operation was performed following which sinuses developed and drained until 1924. In 1923, the right knee joint became swollen and was later complicated by draining sinuses. The knee was immobilized by plaster for twenty months, the drainage ceasing after two years. Tuberculous involvement of the cervicothoracic spine was first diagnosed in 1924. A posterior mediastinal abscess developed and drained through several sinuses on both sides of the neck. He was hospitalized in 1925 on account of the vertebral tuberculosis. At the time of discharge several months later, the sinuses on the left side of the neck had healed but slight drainage persisted from the right.

* The author wishes to express his appreciation to Dr. William C. Black, Professor of Pathology, University of Colorado School of Medicine, for making this case available for study.

From 1925 until admission to the hospital in 1931 the drainage from the sinuses on the right side of the neck continued to increase slowly, being especially pronounced since 1930. He was also suffering from pain which radiated down the right arm. Limitation of extension and pain of the right elbow joint occurred in 1930.

Entrance examination in 1931 revealed a marked kyphosis involving the lower cervical and upper thoracic vertebrae associated with a draining sinus at the right base of the neck. The mediastinal abscess had increased somewhat in size. The right elbow joint was essentially negative for any pathological condition, except for slight limitation of extension. A roentgenogram of the elbow, taken at this time, did not reveal any osseous changes. The right wrist joint was somewhat puffy, with very little restriction of motion. The scars of the previous operations were noted. The circumference of the right knee joint was slightly greater than the left. The fingers showed a moderate degree of clubbing.

A notation in the entrance record stated that "numerous subcrepitant and crepitant rales over the lower two-thirds of the chest, especially posteriorly, were present." The patient did not cough or raise. It was thought that "these rales may indicate either a parenchymal tuberculous lesion or a slight degree of atelectasis due to prolonged bed rest."

Hospitalization was uneventful until 1934, at which time he experienced pain in the left ankle joint. This symptom disappeared spontaneously within a short period. Several months later, the pain, accompanied by swelling, recurred. Roentgenograms did not reveal bone changes. The treatment consisted of applying an elastic bandage.

In June, 1934, the patient complained of abdominal distress, nausea, jaundice and pain over the right upper quadrant. The liver was

There were no further events of importance until June 24, 1935, when the patient began to complain of pain in the right forearm. No

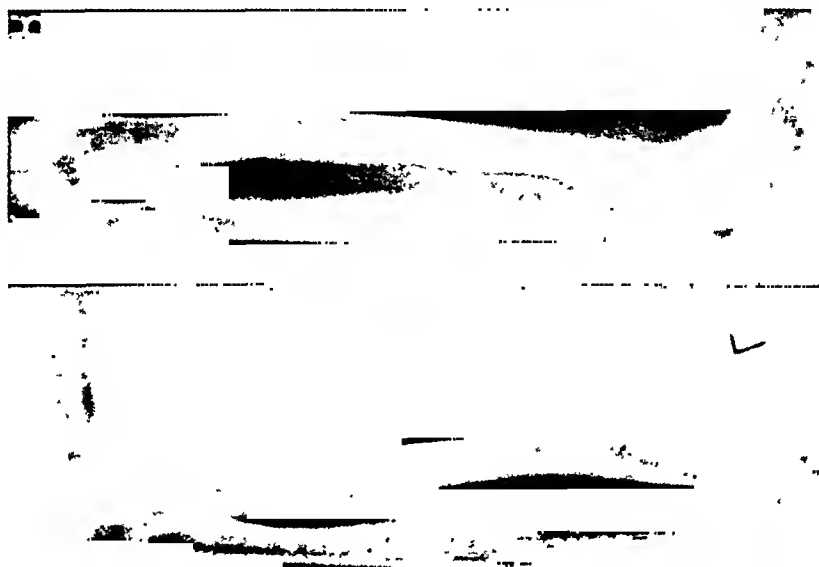


FIG. 1. Roentgenogram taken June 27, 1935. The ulnar shaft does not show any osseous changes.



FIG. 2. Check roentgenogram taken July 20. Marked destruction of the ulnar diaphysis is seen.

enlarged, extending three fingers' breadth below the costal margin. A diagnosis of acute catarrhal jaundice was made, and appropriate treatment was instituted. Following the attack, the liver continued to enlarge slowly until it reached the level of the umbilicus where it remained.

In October, 1934, a slight effusion developed in the left knee joint, disappearing spontaneously after a few weeks.

history of trauma was obtained. The pain was situated about the junction of the proximal and middle thirds, being accompanied by swelling and a slight increase in local temperature. A roentgenogram taken on June 27 did not reveal any osseous changes. (Fig. 1.) Although the extremity was immobilized in a plaster splint, the pain did not subside. Examination of the involved area on July 20 showed

localized swelling associated with erythema and slight increased local heat. Fluctuation and marked tenderness on pressure were present. The white count was 15,000 cells with 85 per cent polymorphonuclears. A roentgenogram, taken on this date, showed a rarefied area in the proximal third of the ulnar diaphysis, about three inches from the joint, the cortex as well as the medullary canal being destroyed. There were no signs of metaphyseal involvement, and the elbow joint was clear. (Fig. 2.)

Because it appeared on July 20 that the abscess would rupture spontaneously, 10 cc. were first aspirated under aseptic precautions for study. A small incision was then made, from which about 50 cc. of thick, yellow pus were expressed. A posterior, moulded, plaster splint was applied to the entire extremity. A direct smear of the aspirated pus did not reveal tubercle bacilli or any other organisms. Culture of the pus for pyogenic organisms was negative. A guinea-pig which was inoculated with the pus died on September 19, tuberculosis being found at autopsy.

Several days following aspiration, abnormal mobility of the ulna was noted at the site of the abscess which had refilled. A diagnosis of pathologic fracture was made. Adequate incision and drainage were performed on July 30, at which time the pathologic fracture was verified. Soft tissue and several small fragments of bone were taken for histologic study. Vaseline packing was inserted and a cast applied. The microscopic examination of these specimens showed typical tuberculous caseation and granulation tissue.

A check roentgenogram, on August 19, revealed increased destruction of the ulnar shaft with no reparative signs. (Fig. 3.) An apparent attempt to bridge the defect in the shaft was noted in the roentgenogram taken on October 18. (Fig. 4.) There was no increase in the degree of destruction. The metaphysis and elbow joint were negative for any pathological condition in both films.

The postoperative course of the forearm was uneventful, although the wound continued to drain until death. In September, 1935, the patient began to complain of marked abdominal discomfort accompanied by ascites. The sedimentation rate increased to 99 mm. in one hour. A diagnosis of tuberculous peritonitis was made. On October 2, paracentesis abdominis yielded 1,000 cc. of serosanguinous fluid.

Quantities as large as 5,100 cc. were aspirated on various occasions following the first tapping. Anasarca appeared on November 13. He



FIG. 3. Check roentgenogram taken August 19. There is almost complete local dissolution of the ulnar shaft.

gradually became weaker and died on November 27, 1935.

AUTOPSY FINDINGS

General. A complete autopsy was performed about sixteen hours after death. A brief summary of the more important findings will be given. The pulmonary tissue showed evidences of a long-standing tuberculous process with marked scarring of both apices. The paravertebral abscess caused compression of the right apex, being demarcated from the pulmonary tissue by a very thick, fibrous wall. The cardiac musculature was flabby. Upon opening the peritoneal cavity a large amount of serosanguinous fluid escaped. Generalized peritonitis was present, the peritoneum being studded with various sized tubercles. There were adhesions between many loops of bowel. The liver margin extended to the level of the umbilicus. The spleen was also enlarged. Amyloidosis of both organs was noted.

Skeletal. The proximal half of the right ulna and radius was removed. The kyphotic spine was also taken for study. The specimen of the

ulna consisted of the proximal 16.5 cm. (Fig. 5.) The shaft of the ulna was rounded approximately 7.5 cm. from the articulation. The

of the fracture. Osseous tissue was not palpable in this bridge. The rounded end of the proximal fragment was smooth; however, the apposing



FIG. 4. Check roentgenogram taken October 18. An apparent attempt has been made to bridge the defect.

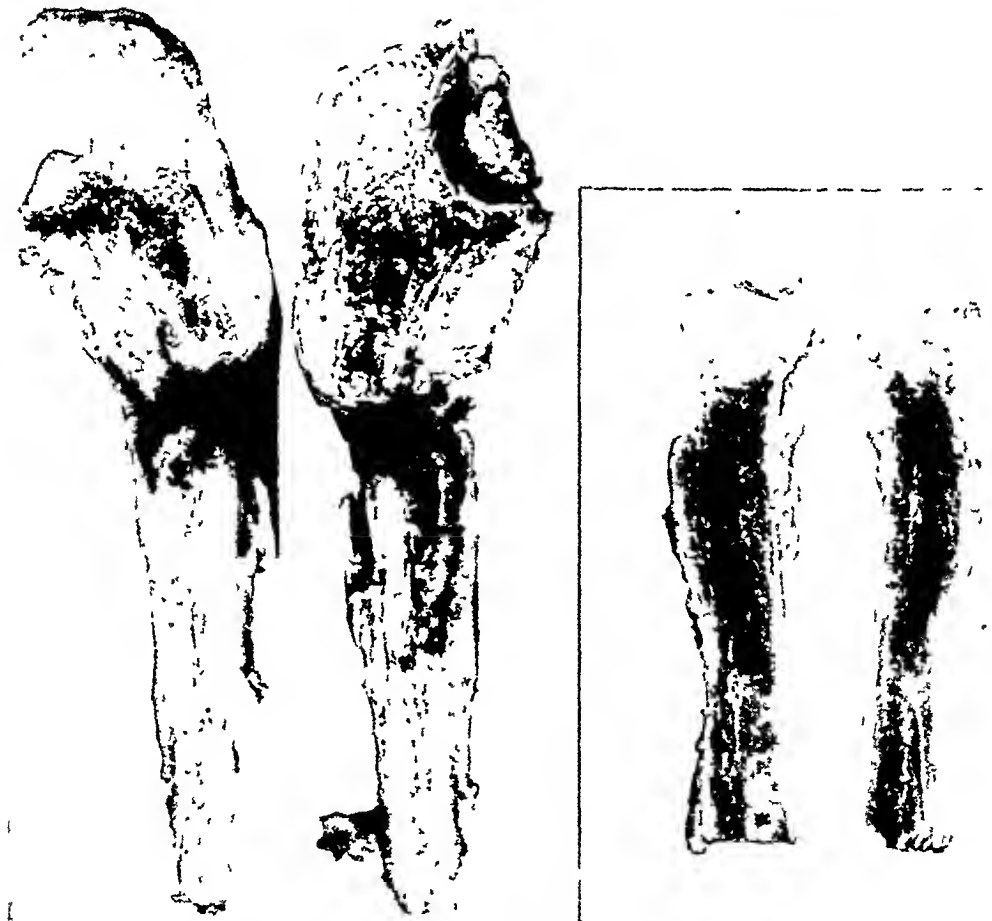


FIG. 5. Gross specimens of the ulna and radius obtained for study.

apposing end of the distal fragment was likewise rounded. The two fragments were separated by a distance of 1.0 cm., the gap being filled with reddish-stained, soft tissue. The pieces at this point could be moved in any direction, denoting the pathologic fracture. A band of scar tissue traversed the volar aspect

end of the distal fragment was eroded for a distance of 1.0 cm. The area of erosion was filled with greyish-white tissue.

On section, the cancellous bone of the metaphysis and epiphysis of the proximal fragment appeared uninvolved grossly. The marrow tissue in these regions was fatty. The com-

ponents of the distal fragment were also negative grossly with the exception of the region directly adjacent to the pathologic fracture.

(Fig. 6.) In places, this tissue was densely infiltrated with pus cells.

The proximal end of the distal fragment was

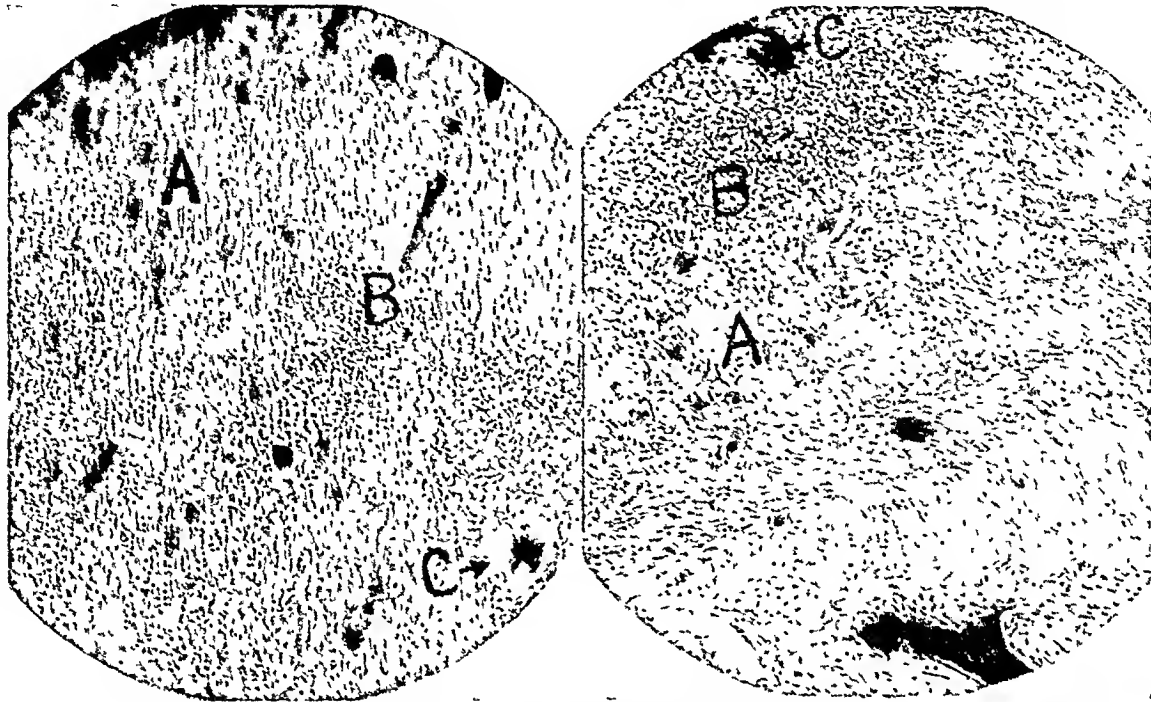


FIG. 6. Photomicrograph of scar tissue from the ends of ulnar fragments. A, numerous capillaries; B, lymphoid cells; C, Langhans' cell. $\times 150$.

The articular cartilage of the semilunar notch was absent in the middle third, exposing the underlying bone. The remaining cartilage was thin and atrophic.

Gross examination of the radius did not reveal any significant changes, including even that portion of the bone which was directly opposite the involved area of the ulna. (Fig. 5.) On hemisection no pathologic findings, either in the osseous or marrow tissue, were noted.

Microscopic. Examination of the semilunar notch revealed that the articular cartilage was lacking in the central third and was very thin wherever present. It was atrophic in appearance with enlargement of many lacunae. There were no changes in the subchondral zone.

The metaphysis was entirely clear, the marrow being fatty with a sprinkling of hematopoietic elements. As the fracture site was approached, the fatty marrow was found replaced more and more by connective tissue. The first tuberculous area in the medullary canal was encountered 1.5 cm. from the site of fracture. In the immediate vicinity of the fracture, the marrow tissue was entirely fibrous. The end of the proximal fragment was covered by very vascular scar tissue. Numerous, large, Langhans' cells were encountered in this region.

likewise covered with scar tissue in a manner similar to that of the described fragment. The tuberculous process extended 0.5 cm. into the medullary canal. The periosteum was infiltrated with tuberculous elements for 2.5 cm. along the shaft. The cortex contiguous to this area showed a slight increase in osteoclastic activity.

Osteoporosis of the cortex of both fragments was very pronounced. A few small areas of osseous proliferation were encountered at the ends of the fragments.

Study of the radius which was adjacent to the area of ulnar involvement did not reveal any tuberculous changes. Osteoporosis of the cortex was present, but not in the marked degree noted in the ulna.

COMMENT

The diaphysis of the ulna was attacked thirteen years after the first skeletal area was involved. During this time, several regions had definitely been attacked by tuberculosis, namely, the right wrist, right knee and cervicothoracic spine. There had also been transient symptoms of the left knee and ankle, which might possibly have been upon a specific basis. Reichel⁵ believed that tuberculous osteomyelitis usually oc-

curred in individuals with multiple bone involvement, although this is not always the case.⁶ It is noted that this patient had several bones infected prior to the development of the diaphyseal localization.

Evidence that this case was definitely one of primary diaphyseal localization and not an extension from a metaphyseal focus was proven histologically. The metaphysis was devoid of tuberculous areas. The focus in the ulnar diaphysis was probably due to the plugging of a vessel by a large embolus containing tubercle bacilli, according to the idea originated by Koenig.⁷ Shutting off the principal blood supply to the region must have played an important rôle in the rapidity of the destruction. Simple proliferation of organisms which had adhered to the vascular endothelium with subsequent obliterative endarteritis tuberculosa, according to the theory of Orth,⁸ could hardly account for such rapid dissolution of cortical tissue.

The previous repeated insults to the skeletal system should also be considered an etiologic factor. They may possibly have so worn down the resistance of the host that he was unable to withstand the effects of a large infected embolus.

From the histologic findings, it appears that the destructive process blew out through an abscess, rather than by extension along the medullary canal which was involved for only a short distance in either fragment. This picture does not coincide with the classical description of the infiltrative type of diaphyseal lesion, in which the tuberculous process extends for considerable distances along the medullary canal. It was noted histologically that the tuberculous elements could be traced for a maximum distance of only 1.5 cm. in the medulla, which is considerably less than may reasonably be expected. This case is apparently a combination of the so-called localized and infiltrative types, the infiltrative process being intensely more destructive than that usually encountered.

There was no clinical evidence at any time of sequestrum formation, the destruction of the cortical tissue apparently being

complete. The absence of the articular cartilage of the semilunar notch was due to atrophy of disuse rather than tuberculosis of the ulnar metaphysis or epiphysis, which would have left some histologic trace of irreparable tissue damage.

Involvement of the ulna in this case corroborates the frequency with which this bone has been reported to be a site of predilection for diaphyseal tuberculosis by some authors.^{7,9} Carrell and Childress,⁶ on the other hand, found the tibia and femur to be the most frequently involved bones. Trauma, which may be a factor in the localization of the disease in certain cases, was not present in this instance.

SUMMARY

1. A case of tuberculosis of the ulnar shaft is reported, wherein massive destruction of the cortex took place. A spontaneous pathologic fracture occurred within four weeks from the onset of the first clinical symptoms.
2. This case represents a localized, infiltrative and rapidly destructive type of diaphyseal tuberculosis hitherto not reported.
3. The pathogenesis of such a lesion is discussed.

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ABDOMINOPERINEAL RESECTION WITH UNUSUAL COMPLICATIONS*

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INTRODUCTION

THOSE of us who have had experience with the one-stage abdominoperineal resection of Miles for carcinoma of the rectum have come to expect complications of various types. Bladder dysfunction which may be followed by urinary infection is probably the most common complication. Cardiovascular accidents, pulmonary embolism, pneumonia and the usual long list of postoperative complications seen in all types of abdominal surgery are encountered. It is beyond the scope of this article to discuss their diagnoses and management.

CASE REPORT

Mr. J. F. C., white, male, age forty-six, a government clerk by occupation, was referred to me on February 17, 1940. He had been treated by a chiropractor for bleeding hemorrhoids in 1937 and 1938. Stool examinations, made in two different laboratories in the fall of 1938, were positive for blood. No parasites were found. A gastrointestinal series and barium enema, with air contrast, were reported as normal by a competent radiologist in the fall of 1938. The patient was lost sight of until January, 1940, when he consulted Dr. L. H. Snyder stating that he had been treated (unsuccessfully) elsewhere for ulcerative colitis. Dr. L. H. Snyder referred him to this office on February 17, 1940, at which time a proliferative and ulcerative carcinoma of the upper rectum was seen upon proctoscopic examination. The lesion was located at 5 inches, it was quite large, freely movable and was complicated by hemorrhoids. Biopsy revealed it to be an adenocarcinoma-cylindrical cell type, Grade 3 (Dr. O. B. Hunter). A preoperative period of ten days' preparation was used and on February 27, 1940, a one-stage abdominoperineal

resection (Miles) was done without any technical difficulty at Emergency Hospital. At operation the regional lymph-nodes were involved and a nodule about 1 cm. in diameter could be felt on the undersurface of the left lobe of the liver. The permanent colostomy emerged from the midline incision midway between the umbilicus and pubes. The left colic gutter was not closed as has been suggested by Rankin² as we do not make a left McBurney stab-wound type of colostomy. Microscopic sections of the specimen by Dr. L. Newman showed an actively proliferating adenocarcinoma Grade 3 which infiltrates the muscle and the regional lymph-nodes (Dukes Classification Type c). The patient had a satisfactory postoperative course, being allowed out of bed on the twentieth postoperative day.

About noon on the twenty-first postoperative day, March 19, 1940, the patient felt a sudden, severe, cramping pain in the left lower quadrant. The pain was gripping in character and occurred while he was standing on the footstool in the act of climbing into bed. Examination one hour later revealed a splinting of the left side of the abdomen with rebound spasm. Upon inserting the finger into the colostomy, the space between the colostomy and the left anterior iliac spine felt rather full and was exquisitely tender. *One could not approximate the finger inserted into the colostomy and the hand on the skin of the left lower quadrant.* (Fig. 1.) Decompression was attempted with the Miller-Abbott tube during the late afternoon and overnight. An x-ray in the morning revealed the tube to be coiled up in the stomach. The large and small intestine showed dilated loops typical of obstruction. The patient was sent to the operating room with a diagnosis of small bowel obstruction due to a herniation down the left colic gutter. Under spinal anesthesia the abdomen was entered through a right rectus incision. A loop of small intestine (probably jejunum) had rotated and strangu-

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FIG. 1. Showing the method of examination for herniation and strangulation around the colostomy.

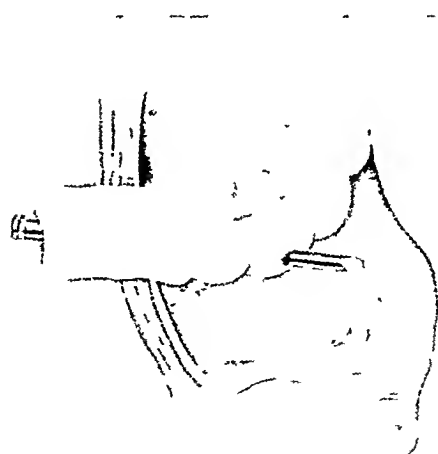


FIG. 2. Perforation of colostomy by catheter.

lated itself around the colostomy by descending in the left colic gutter. The gangrenous gut was delivered with difficulty and without rupture. Sixteen inches of bowel were resected and an end-to-end anastomosis performed. Enterostomy was not done. The abdomen was closed without drainage. The patient made a satisfactory recovery until the fourth postoperative day when he developed a phlebitis of the left leg. The edema and swelling did not extend much above the calf and he was allowed out of bed on the nineteenth postoperative day and discharged home, April 15, 1940, the twenty-fifth postoperative day, it then being forty-seven days since his abdominoperineal resection.

The patient had been instructed to take a daily enema before breakfast in the following manner: He was to insert slowly a No. 28 F. catheter into the colostomy for about 3 inches. A wash cloth, wrapped around the catheter, was to act as a stopper and prevent leakage until about 1,000 cc. of plain water was used. The return flow was to be expelled into the enema can or the toilet bowl. He was not confined to the house and was gaining weight and strength in anticipation of his return to work about May 15, 1940.

About 8:00 A.M., May 8, 1940, he inserted the tube with slight difficulty and "the lukewarm plain tap water ran in easier than ever before." There was no pain or cramps and no return from the enema. He felt well for about one and one-half hours and about 9:30 A.M. he was seized with violent peristaltic cramps. The abdomen became hard and rigid. He had a chill and when I was called to see him about 1:00 P.M. he was in a state of shock with a board-like abdomen. A diagnosis of perforation of the colon was made (Fig. 2) and he was again admitted to the hospital. Roentgen examination of the abdomen in the prone and upright position revealed some dilatation of the stomach but no free air under the diaphragm. About 5:30 P.M., under spinal anesthesia, the old right rectus incisional scar was removed and the abdomen opened. Both clear and cloudy fluid containing a few flakes of feces escaped. A considerable amount of fluid was removed by suction. The culture of this fluid subsequently showed *Bacillus coli* and *Bacillus aerogenes*. The site of perforation could not be found as the patient's condition did not warrant prolonged search for it. Repair of the perforation was therefore not done. A penrose drain was

inserted toward the pelvis and the incision closed by through-and-through sutures of alloy steel wire. The patient had a stormy postoperative course. Frank purulent drainage did not appear until about the tenth postoperative day, the drain being removed the twelfth postoperative day. From the fifteenth postoperative day the patient began to improve. He was finally discharged the twentieth postoperative day and the wound closed spontaneously without retention of pus about nine weeks later. He returned to his previous occupation about September 1, 1940, weighing 128 pounds (six pounds more than when I first saw him). When last seen June 18, 1941, his nutrition was good and his blood count was within normal limits.

COMMENT

This case needs very little comment, except to pay tribute to a heroic individual who has survived his surgeon's efforts to date. His reward should be greater than I anticipate for him in the future, as he had a Grade 3 (Broders) type c (Dukes) adenocarcinoma of the rectum with infiltration of the regional lymph-nodes and a nodule in the liver. He has been restored to his previous occupation which is some justification for his additional operations. It is obvious that these additional operations were carried out with scant enthusiasm on my part as they were well tinctured with a pessimistic outlook for the patient.

It is of interest that this strangulation occurred around a colostomy placed in the midline. This colostomy location leaves a rather large space down the left colic gutter. A colostomy made in the left lower quadrant actually creates a small opening for an internal hernia if the peritoneum is not closed with a purse string suture. In this case the peritoneal space between the midline colostomy and the left colic gutter was left open as we believed it was too large an area to permit strangulation.

Finally, it is to be noted that perforation of the rectum or bowel by enema tips and allowing the enema to enter the peritoneal cavity probably carries a mortality rate greater than 40 per cent.¹

CONCLUSIONS

1. A case of abdominoperineal resection (Miles) of the rectum is reported.
2. Volvulus, strangulation and herniation of a loop of small intestine down the left colic gutter and around the colostomy is reported as a complication.
3. Perforation of the colon (colostomy) by a soft rubber catheter and the administration of an intraperitoneal enema is also reported as a complication.
4. *Inability to approximate the finger inserted into the colostomy and the hand placed*

*on the skin of the left lower quadrant is reported as a finding in herniation of the small intestine down the left colic gutter. Obliteration of this palpable space accompanied by exquisite tenderness and a board-like abdomen favors the diagnosis of strangulation.**

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* An additional case of volvulus has been encountered since this report.



BENNETT emphasizes that when paralysis occurs during poliomyelitis, an estimate of the injury to the anterior horn cells of the spinal cord cannot be made, but muscles presenting varying degrees of weakness must be considered. The degrees of recovery depend upon the extent of damage to the cells of the spinal cord.

GASTROJEJUNOCOLIC FISTULA*

REPORT OF A CASE

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MILWAUKEE, WISCONSIN

GASTROJEJUNOCOLIC fistula is a comparatively rare complication following gastrointestinal surgery. We¹ made a collective review of the literature, and found that only 322 cases of gastrojejunocolic fistula have been reported since 1893. It may be that many other cases existed but were overlooked or not recognized.

In our study of the literature we found that the average case of gastrojejunocolic fistula occurred within four and one-half to nine years following gastroenterostomy, while a few cases have been reported as early as six weeks following surgery, and some eighteen years later. The case that we are reporting, is of particular interest because a gastrojejunocolic fistula developed twenty-one years after a gastroenterostomy for duodenal ulcer, and we know of no other instance in which this complication occurred at such a late date.

CASE REPORT

A. S., a white male, blacksmith, age thirty-two, married with one living child, was first admitted to Mt. Sinai Hospital on July 16, 1919. He gave a history of epigastric pain and distress for two years. The pain in the stomach became most severe after eating and was aggravated by all kinds of food. Soda did not relieve the pain. For three weeks preceding his admission to the hospital the pain had become progressively worse and the patient had several attacks of vomiting. He noticed that the vomitus was of a coffee-ground color. He also lost twelve pounds in those three weeks.

Upon physical examination the patient was found to be fairly well developed and well nourished. The pulse, temperature and respirations were normal. The blood pressure was 126/70. In the epigastrium there was spasm of

the recti muscles and tenderness and rigidity over the pyloric region of the stomach. At the end of fifteen minutes, following the administration of a barium meal, no duodenal cap was visualized, the stomach was of immense size and there was a large dilated pylorus. At the end of six hours, no duodenal cap was present; nothing was seen passing through the pylorus and the fundus was contracted and the pylorus dilated. At the end of twenty-four hours, there was considerable gastric retention, the pylorus was still full, there was some barium in the cecum and the pyloric mass was movable.

The preoperative diagnosis was pyloric obstruction due to a scarred ulcer or malignancy.

The operation was performed by the senior author (M. B.) on July 18, 1919. The stomach was found to be dilated. A mass the size of a fist was felt in the posterior portion of the pylorus. This mass was adherent to the gall-bladder and duodenum (at the site of an old adherent ulcer) and to the head of the pancreas. A partial gastrectomy was performed followed by a posterior gastroenterostomy. Postoperative diagnosis was pyloric obstruction caused by peptic ulcer with much scar formation.

Twelve days later the patient was discharged from the hospital in excellent condition. During the years that followed the patient gained weight and resumed his work without symptoms.

On January 16, 1940, the same patient, now aged fifty-three, with six living children, a painter for the past twelve years, was admitted to Mt. Sinai Hospital for the second time. At this time he gave a history of abdominal pain, onset three years ago, which had gradually become worse. The pain was sharp and burning in character and spread over the lower abdomen, whereas, the pain twenty-one years ago was present just below the xiphoid. The present pain usually came on one and one-half to two hours after eating, was accompanied by dis-

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tention, bloating, "rumbling," and was relieved by defecation, alkalization or milk. The pain was usually present when his stomach was empty. For the past eighteen months the patient had a persistent diarrhea, and frequent emeses of fecal material. About two years ago the patient noticed bright red blood in the stool following an attack of diarrhea but lately no blood had been noticed. His appetite was good; there was no qualitative food intolerance except for apples. For the past year he has persistently felt weak and tired and lost thirty-five pounds in weight.

Upon physical examination the patient was found to be rather emaciated, very weak, and a generalized pallor was present. He weighed one hundred thirty pounds. The temperature, pulse and respirations were normal. The blood pressure was 120/74 and the heart and lungs were essentially negative. The abdomen was protuberant. There was an old healed sear in the right upper quadrant, with a defect and expansile mass (a ventral incisional hernia). No tenderness, masses, or rigidity were noted. He had bilateral varicose veins, otherwise, the extremities were negative. The leucocyte count of the blood was 7,450 per cubic millimeter; the hemoglobin measured 69 per cent; the erythrocyte count was 3,310,000 per cubic millimeter; poikilocytosis, anisocytosis and hypochromia were present. The blood sugar was 117.6 mg. per 100 cc. and the blood non-protein nitrogen was 22.5 mg. per 100 cc. The urine was essentially negative.

The preoperative diagnosis was gastrojejunal ulcer with possible fistula.

On January 18, 1940, following adequate preoperative therapy, the patient was taken to the operating room and under nitrous oxide induction followed by ether anesthesia, a left rectus incision was made. Upon exploring the abdomen a gastrojejunoecolic fistula was found. The involved transverse colon was excised widely, and all indurated colon which might be malignant was removed and an end-to-end colonic anastomosis was done. The previous posterior gastroenterostomy was taken down.

The jejunum was excised at the site of the ulcer and a new gastric opening was made and this was anastomosed to a loop of jejunum distal to the repair of the previous jejunal opening thus creating a new gastroenterostomy. The abdomen was closed in layers and without drainage. The operation was quite difficult owing to multiple adhesions.

Fourteen days later the patient was discharged in excellent condition. He was seen on April 20, 1940, and at that time he had regained twenty-five pounds, was feeling stronger and had no complaints or symptoms. He had resumed his work. He was last seen on September 14, 1940, and at that time he weighed one hundred seventy pounds. His appetite was good, and he had no gastrointestinal symptoms whatsoever.

CONCLUSION

A case is reported of a gastrojejunoecolic fistula which developed twenty-one years after a primary operation (partial gastrectomy and posterior gastroenterostomy) for duodenal ulcer. Recovery followed when a secondary operation was performed, at which time the gastrojejunoecolic fistula was resected, colonic end-to-end anastomosis done, and a new gastroenterostomy created, after the previous posterior gastroenterostomy was taken down. The treatment of this condition is surgical intervention, for the fistula is of a progressive nature, and death will result if the fistula is not recognized and treated properly.

This report seems to be justified, for, in our review of the literature, we found no other case of gastrojejunoecolic fistula which developed at such a late date.

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CARCINOMA OF THE COLON IN A CHILD OF FOURTEEN YEARS*

WITH A REVIEW OF THE LITERATURE

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IN reviewing the recent literature one is impressed with the frequency of reports dealing with neoplastic lesions in infancy and early childhood. No detailed survey is available regarding the distribution of cancer in children, but apparently the kidney and ovary are more frequently involved than any other organs. The percentage of lesions occurring in the colon, however, corresponds rather closely to that in adults. Fowler⁴ (1926), in reviewing a large number of malignancies in patients under twenty-six years of age, found that 18.7 per cent involved the large bowel, and of these 12.5 per cent occurred in the rectum and sigmoid. Louart⁵ (1900) was the first to review the literature, collecting seventy-six cases of cancer of the large intestine, excluding the rectum, but he included patients up to the age of thirty. Bauer and Bertin² (1914) added twenty-one additional cases. Phifer¹⁴ (1923) reported forty-nine cases of proven cancer of the sigmoid and rectum under the age of twenty-one years. Twenty-two of these patients were under the age of fifteen. Bacon and Sealy¹¹ (1939) found one hundred twenty-three authentic cases of malignancy of the sigmoid, rectum, and anus under the age of twenty, and of these, fifty-one occurred under the age of fifteen. Other than one case which occurred in a newborn monster, the youngest patient in this series was three years of age.

This report deals with malignancy of the colon, proximal to the sigmoid, and is limited to patients under the age of fifteen. The first case was reported by Spanton and

Frost¹⁹ (1878), and occurred in a female twelve years of age. Since that time there have been seventeen additional cases reported. These are summarized in Table 1.

Of the eighteen cases, nine occurred in males and nine in females. The cecum was involved in 50 per cent of the cases; of the remaining nine, the lesion was located in the ascending colon in two cases, in the transverse colon in two cases and in the splenic flexure in five cases. In fourteen cases the symptoms were reported, and in all, the presenting symptom was abdominal pain. In addition, nine patients complained of vomiting, six of constipation, and in only two cases was there a history of bloody stools. As pointed out by Bacon and Sealy, this is in contrast to the symptomatology in adults in which bleeding is the most common symptom.

All of the fourteen patients were operated upon; all died except two. Mayo-Robinson⁷ reported that his patient was alive six months after operation and Warthen's²² patient was living three months after operation. In eight of these fourteen cases, the preoperative impression was either tuberculous peritonitis or obstruction due to tuberculosis.

CASE REPORT

A fourteen year old, American male was admitted to the Surgical Service of the Laird Memorial Hospital on October 23, 1938, complaining of generalized abdominal pain, general malaise and progressive weight loss. The patient's past health had been excellent and there was no history of carcinoma or tuberculosis in the family.

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The present illness began in August, 1938, when he first noticed the gradual onset of vague, cramp-like, abdominal pain, which distention was first noted. This had gradually progressed to the point that he was quite dyspneic. His weight had dropped from one

TABLE I

	Sex	Age	Location	Symptoms	Microscopic Diagnosis
Walker and Daly ²⁰	M	5	Cecum	Abdominal pain, vomiting	Adenocarcinoma
Pfeiffer and Wood ²	M	7	Transverse colon	Abdominal pain, constipation	Fibroma with adenocarcinoma
Phal ¹²	F	9	Cecum		
Mouchet and Baranger ⁴	F	10	Splenic flexure	Abdominal pain, vomiting	Adeno-epithelioma
Wainwright ²²	F	11	Splenic flexure	Abdominal pain, diarrhea	Gelatinous carcinoma
Rocher and Guerin ¹⁷	M	11	Splenic flexure	Abdominal pain, vomiting	Epithelioma
Spanton and Frost ¹⁹	F	12	Cecum	Abdominal pain	Encephaloid
Maydl ⁶	F	12	Cecum		
Nothnagel ¹⁰	M	12	Cecum		
Maydl ⁷	M	13	Cecum		
Ruczynski ¹⁵	M	13	Splenic flexure	Abdominal pain, bloody stools	Adenocarcinoma
Muralt ⁹	M	13	Ascending colon	Abdominal pain, vomiting	Colloid carcinoma
Ogilvie ¹¹	M	13	Splenic flexure	Abdominal pain, vomiting	Spheroidal-cell carcinoma
Rawls ¹⁶	F	13	Splenic flexure	Abdominal pain, constipation	Signet-ring adenocarcinoma
Mayo-Robinson ⁷	F	14	Ascending colon	Abdominal pain, constipation	Columnar epithelioma
Chajintin ³	F	14	Cecum	Abdominal pain, bloody stools	Adenocarcinoma
Pouzet ¹⁵	F	14	Cecum	Abdominal pain, vomiting	Epithelioma
Warthen ²²	F	14	Transverse colon	Abdominal pain, constipation	Signet-ring adenocarcinoma

began in the left upper quadrant and radiated over the course of the colon. This was accompanied by general malaise, anorexia and a low-grade fever. The pain increased in severity, and ten days prior to admission some abdominal

hundred fifteen pounds to eighty-five pounds. The bowels had continued to move normally and no blood was noted in the stools.

Physical examination on admission revealed an emaciated, dehydrated, acutely ill patient.

His temperature was 99.8°F. The head and neck presented no abnormalities. The heart and lungs were normal but the diaphragm was

entire abdomen but there were no palpable masses or viscerae.

Routine laboratory studies revealed an



FIG. 1. Photograph of the splenic flexure of the colon showing the artificial passage.*

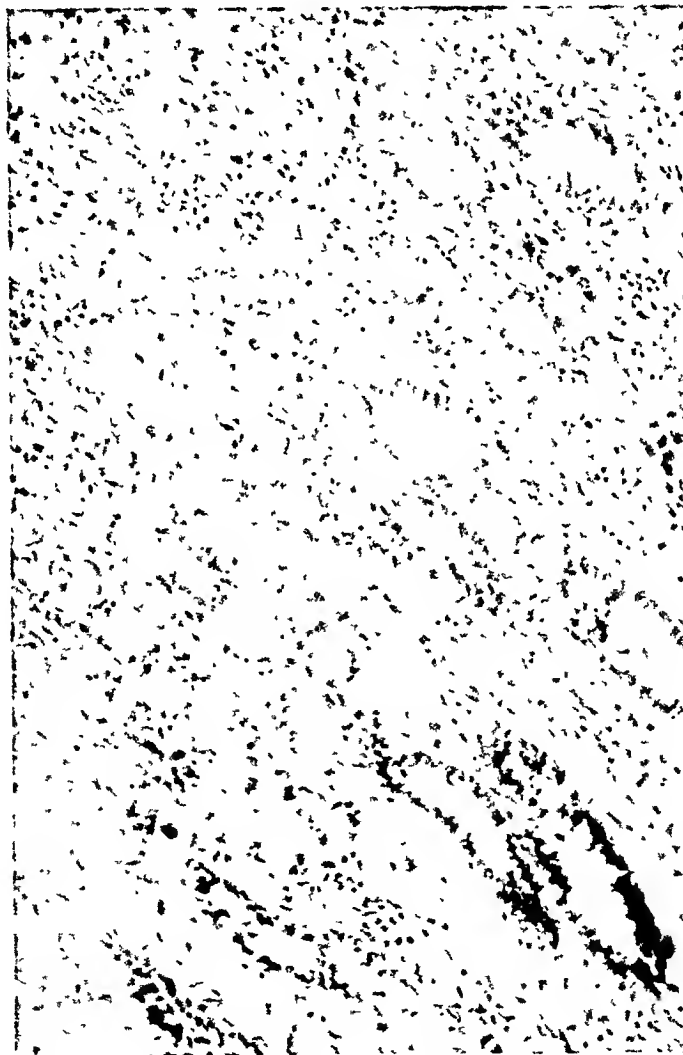


FIG. 2. Photomicrograph of the section from the splenic flexure showing invasion of the wall of the intestine by tumor cells.*

elevated. The abdomen was symmetrically distended with fullness in the flanks and shifting dullness. There was slight tenderness over the

* Photographs by Army Medical Museum.

erythrocyte count of 4,700,000; hemoglobin 90 per cent; leucocyte count of 17,000, with 70 per cent polymorphonuclear leucocytes. The Kahn test and urinalysis were negative. There was no

occult blood in the stools. Fluoroscopic and roentgenologic examination of the chest and spine were negative.

With a tentative diagnosis of tuberculous peritonitis the abdomen was explored through a midline incision under ether anesthesia. Approximately three liters of clear, amber fluid were removed. The omentum consisted of a mass of irregular, white, translucent, discrete nodules, varying in size from $\frac{1}{2}$ to 3 cm. The entire parietal peritoneum and mesentery were covered with similar nodules, and the splenic flexure of the colon and spleen were bound together in a large mass. There were no dilated loops of intestines noted. The liver and stomach were free of invasion. An omental biopsy was obtained and the abdomen closed.

The wound healed but the postoperative course was steadily retrograde. The abdomen gradually became distended and the patient died thirty days following operation. This was three months after the onset of the symptoms.

Pathological Report. The examination was limited to the abdomen. The stomach, duodenum, liver and kidneys were grossly normal. There were many large, pedunculated tumor nodules hanging from the colon and spleen. These organs, with the tail of the pancreas, were bound together in a large mass which was removed in toto. After fixation, the mass was opened from below upward; and at the splenic flexure there was marked thickening of the walls with almost complete obstruction of the lumen. Through this mass, which was yellow-white, soft, and resembled a colloid carcinoma, there was a false passage measuring approximately 3 by 3 by 3 cm. (Fig. 1.) Fragmentary portions of muscle wall could be seen in the mass. There was no gross evidence of leakage.

Microscopic. For sake of simplicity the operative biopsy is being included in the necropsy report. The sections of omentum removed at operation showed various sized nodules composed of a delicate network of fibrous tissue supporting tumor cells. The cells were anaplastic, pleomorphic and hyperchromic. The cytoplasm was light and faintly granular, and the nuclei were, for the most part, eccentrically placed. Numerous, atypical, mitotic figures were seen. Between the cells there was a matrix taking the hematoxylin stain which appeared to be of colloid nature. In numerous areas the cells assumed an atypical, glandular structure. In the sections taken from the tumor of the colon

the cells had the same general characteristics. However, the gland formation was more definite and on the inner border there were degenerative changes with infection superimposed. (Fig. 2.) The false passage described grossly was lined with a thick necrotic membrane resting upon degenerative tumor cells. Microscopic studies of the remaining viscera revealed no histological evidence of metastatic tumor.

Diagnosis: Colloid adenoma of the splenic flexure of the colon.

CONCLUSIONS

Eighteen authentic cases of carcinoma of the colon are reported occurring in children under the age of fifteen years and proximal to the rectosigmoid junction.

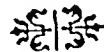
A case report is presented of colloid carcinoma of the splenic flexure of the colon in a white male of fourteen years.

In the fifteen cases in which the histories were reported, all patients complained of abdominal pain as the presenting symptom, and in only two cases was there a history of bloody stools. This is in direct contrast to the symptomatology in adults in whom rectal bleeding is the most frequent presenting symptom.

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THE chief life-saving measures are the mechanical respirator, postural drainage, and convalescent serum. The chief agents for the prevention of deformity are proper bed posture and splinting.

RECURRING JEJUNAL INTUSSUSCEPTION*

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INTUSSUSCEPTION is one of the less common of the many pathologic conditions producing intestinal obstruction. It may be classified in a variety of ways descriptive of the part involved, such as ileocecal intussusception, which is the commonest type, the ilocolic, the colonic and the enteric. The enteric type may be subdivided into the ilcal, the ileojunal and the jejunal. An intussusception may be peristaltic or antiperistaltic, and both of these have been found in the same patient. Furthermore, retrograde intussusception has been found through a gastroenterostomy stoma.

From the standpoint of symptomatology, however, there are only two general classifications. The first or common form is the ileocecal variety, which occurs in children usually under the age of two years and which has a clinical symptom complex with which we are all familiar. Except in a few rare cases in which there is spontaneous reduction, this type of intussusception, unless reduced by inflation or enemas, constitutes an acute abdominal emergency which requires immediate laparotomy. Furthermore, when once reduced during laparotomy, it is unlikely to recur. The ileocecal variety has been thoroughly recorded and discussed in many articles, but the jejunal type has a different group of symptoms and it is not so well understood. Despite this, it has a symptomatology that is rather characteristic and which should call for a correct diagnosis in most instances. The fact that jejunal intussusception is not recognized early is due primarily to a lack of understanding of its characteristic symptoms so that most doctors fail to consider it in a patient with chronic upper abdominal symptoms.

Freilich and Coe, in an excellent article,

have reviewed the literature on jejunal intussusception up to June, 1936. Their findings emphasize its comparative rarity. In 3,284 cases of intussusception reported, there were 462 or 14 per cent of enteric cases, and of these only twenty-nine or 0.9 per cent were of the jejunal type. Additional reports are limited to five other jejunal cases, and these had symptoms in common with those previously recorded.

Statistics indicate that about 5 per cent of all intussusceptions occur in adults, but this figure is practically reversed in the jejunal cases; for although one such case is reported at the age of four months, it appears to be mainly a disease of adult life. It is also a disease associated with some other abdominal pathology, for of the thirty-four cases recorded, twenty-nine had some type of neoplasm present. These lesions either malignant or benign were found within the lumen of the bowel and they were the presumptive factor in producing a telescoping of the bowel. Such underlying pathological manifestations may be present in intussusception of any part of the intestinal tract after the age of two years, but they are apt to be found especially in the jejunal type. Polyps were among the common tumors present in the cases reported. Nine jejunal cases presented double or triple intussusceptions; and while a few were retrograde, one case reported by Ryan and Morgan gave the unusual picture of a quadruple intussusception. Two of these were peristaltic and two retrograde or antiperistaltic, the four being delivered as one mass.

The five remaining jejunal cases had no tumor and no other demonstrable condition that might produce them, so they may be classified as primary or spontaneous. It is interesting to learn that in a few recurring

* Read before the Western Surgical Association at Topeka, Kansas, December 7, 1940.

cases of ileocecal intussusception in which no tumor was discovered within the lumen of the bowel, an abnormally long mesentery was noted, which in the absence of other findings appeared to be a causative factor. This may have been present in these otherwise primary jejunal cases.

An intussusception that has been produced experimentally, tends to reduce itself spontaneously, and this may occur in some of those which develop spontaneously. Undoubtedly, this is true of certain jejunal cases because they have had recurring symptoms, including the presence of a palpable tumor, and later obtained relief of symptoms with disappearance of the tumor. In several cases the same condition obtained many times before an irreducible tumor developed and was found at operation.

When the intussusception is not reduced, the telescoped bowel acts as a foreign body and increased peristalsis tends to force it farther and farther along the intestinal tract. The mesentery is drawn in and pressure upon it produces much of the pain and shock. Further pressure on the mesentery finally interferes with the blood supply and the telescoped portion becomes gangrenous.

Symptoms of jejunal intussusception may be present for months or years and are usually intermittent. There is always a history of upper abdominal pain. This may be exceedingly severe during some attacks, and occasionally it follows the ingestion of food. However, there are numerous attacks of much less severity. A vague pain in the epigastrium may be present most of the time between the severe attacks. Nausea and vomiting are common but only when they accompany the acute symptoms. Blood in the stools, found routinely in the infantile or ileocecal cases, is not of regular occurrence in jejunal intussusception and is recorded in only 25 per cent of those reported. Also a mass palpable during the acute paroxysms of pain is found in over half of these cases. X-ray findings have been reported very seldom and were of diagnostic aid only occasionally, but

they should be under more favorable circumstances.

The following case report is one in which the diagnosis was not made correctly until



FIG. 1. Stomach and colon both displaced by pressure of the central mass.

after laparotomy, but a study of the history indicates that intussusception should have been considered long before an emergency operation became necessary.

This case is of unusual interest because of the duration of symptoms and because of the large amount of tissue that had to be resected (205 cm.).

CASE REPORT

Mrs. E. L., aged thirty-eight, para 3, was seen at the Graham Hospital, Canton, Illinois, on the morning of July 6, 1939, having been taken there while suffering with an attack of severe abdominal pain. She gave the following history: At the age of thirty-three, five years ago, she developed abdominal pains, cramp-like in character, which usually occurred in the morning. These were not severe, lasted only a half hour and then disappeared for from one to two months. Soon, however, they increased both in frequency and severity and she had to vomit because of the associated nausea. At first this gave complete relief, and in subsequent attacks she resorted to voluntary vomiting, which usually caused the pain to leave completely. As the attacks became more frequent she could anticipate them. Eventually, she would be awakened about 2 A.M. with intense

pain, and she would vomit and take enemas with varying degrees of relief. As time passed, vomiting ceased to relieve the condition. For



FIG. 2. Drawing showing appearance and cross section of the tumor.

the past two years she had been uncomfortable most of the time and she had some pain almost every fifteen minutes all day long every day. These pains were not intense as in the occasional severe attacks, but the patient had an uncomfortable feeling and a sense of abdominal movement with slight pain most of the day. She also had become extremely nervous.

She was seen by Dr. R. H. Maguire on numerous occasions when she was suffering from the severe attacks and also in the intervals between them. During these intervals, the physical findings were entirely negative, but when an attack was present, he could feel a definite mass in the right side of the abdomen. Careful manipulation of this mass would cause it to become smaller and smaller, until it finally disappeared and then the patient's symptoms would be relieved at once. However, a definite tenderness would remain about two inches above McBurney's point after the attacks and soreness would persist for several hours. Visible peristalsis was usually present. Dr. Maguire's impression was that the patient had a partial obstruction due to adhesions from a previous appendicitis. Accordingly, he did an appendectomy in May, 1935, two years after the onset of symptoms. The appendix was normal, and a careful exploration of the pelvis and right side of the abdomen failed to reveal any pathological condition to account for the symptoms.

The patient's postoperative course was normal until the ninth day when the old symptoms recurred and a large mass could be palpated, but it again disappeared during the course of the abdominal examination. Several weeks later, another attack occurred, but this time the doctor was unable to feel the mass. On numerous occasions during the next four years he saw her with the same symptoms, but all physical findings were negative. She was very nervous and weighed only one hundred pounds. The heart and lungs were normal as well as the blood and urine. The patient never passed blood in the stools and had no diarrhea with or without the attacks. During the past year, she developed a moderate secondary anemia. Dr. Maguire had had her examined at three different clinics with complete physical, x-ray and laboratory check-ups. The findings were all to the same effect; namely, that she had a spastic colitis, and that her pains were of a spasmodic nature due to some nervous condition. None of these consultants felt the mass and all advised sedatives, rest and diet. These measures failed to bring relief and the condition gradually became worse.

On July 5, 1939, at 3 A.M. she had another attack of abdominal pain. She was seen by Dr. Maguire at 6 A.M. at which time he found her in moderate shock with pain more severe than he had seen her have before, and she had vomited several times. He administered morphine sulfate gr. $\frac{1}{4}$, and within an hour repeated the dose, bringing only slight relief. The mass which was present on this occasion was two or three times larger than when found before and did not disappear upon palpation as it had done routinely in the past. It was sausage-shaped and extended from the right upper quadrant to the pelvis. It was somewhat moveable and there was no additional pain upon gentle manipulation. Again at 10 A.M. another $\frac{1}{4}$ gr. of morphine was given and the pain was completely relieved. At this time, the mass seemed smaller. That night the pain became worse and the patient was removed to the hospital. Upon admission her temperature was 101.2°F., pulse 96, and respiration 24. A soap suds enema was given and returned with feces and a large amount of flatus, following which she was relieved and rested fairly well that night. The following day, the temperature was 99.6°F. and there was not much pain, the urinalysis was negative, hemoglobin 42 per cent, red blood cells 2,230,000, white blood cells 15,900, differential count normal, and

blood type 4 Moss. A large sausage-shaped mass filled the right half of the abdomen and extended over to the left side of the pelvis. It seemed smooth, soft and not especially tender to the touch.

A barium enema was given and an x-ray examination made. It revealed a normal appearing colon partly encircling the mass, which was almost in the midline at this time. The mass did not contain gas and did not look like an obstructed bowel. Under the fluoroscope, no additional information was gained. Barium was given by mouth and it could be seen that the stomach was separate from the mass. At this time the pain recurred, the patient vomited, and she was so distressed that the x-ray examination had to be abandoned for the time being.

Her general condition was very poor and yet she passed gas with every enema. We were not satisfied with the x-ray findings and wanted to repeat them, but her condition did not warrant it. We believed that we were confronted with a paralytic ileus, produced by a large retroperitoneal tumor which because of the fever present was possibly an infected right kidney. We thought two or three days of preparation might make the patient a better operative risk, especially so since the previous attacks had all subsided. She was given intravenous glucose, 2,000 cc. twice daily, and 500 cc. citrated blood. A Levine tube was inserted and a Waugensteen suction apparatus attached. This, with an occasional enema, gave symptomatic relief, but the mass did not change and the patient's general condition was not greatly improved. Her temperature varied from 99.6 to 103.6°F., and the following day her blood findings were: hemoglobin 50 per cent, red blood cells 2,120,000. However, on the next day, July 8 (two days after the x-ray examination), it was obvious that no improvement had occurred and that valuable time was being wasted. An immediate operation was decided upon.

Under local infiltration anesthesia, an upper right rectus incision was made. A large blue mass too large to be delivered appeared covered with peritoneum. Ethylene anesthesia was added, the incision enlarged and the mass delivered. It was found to be a thick, rubbery piece of intestine starting as an intussusception of the jejunum 10 cm. (4 in.) from the ligament of Treitz and involving a part of the ileum. It was about 15 cm. wide by 32.5 cm. long, and yet the mesentery was long enough, in spite of

the edematous dense tissue, to permit the mass to be brought outside the abdominal cavity. Attempts to reduce it were futile, and upon



FIG. 3. X-ray appearance of stomach and small intestine, one year later.

slight pressure, the outer intestinal layer split, revealing another serous coat of peritoneum on the inside which was gangrenous and permitted a spill of intestinal fluid. Thereupon, it was obviously necessary to resect the entire tumor. After the tumor mass was removed and the mesentery sutured, the divided intestinal ends were united in an end-to-end anastomosis with fine silk for the inner layer and No. 00000 catgut for the peritoneal layer. The proximal end being only 10 cm. (4 in.) from the ligament of Treitz made this procedure somewhat awkward, but it was nevertheless accomplished with very little difficulty. The abdomen was closed without drainage and the patient returned to her room, with a pulse of 140, but otherwise in fair condition considering the extent of the operation. The time was one hour and fifteen minutes.

The following day the patient's condition was quite good. The temperature was 102.4°F., pulse 122, and respiration 20. There was remarkably little pain and very little opiate was required. On the fourth postoperative day, the Levine tube was removed and the patient began to retain fluids by mouth in small amounts, although the intravenous administration of fluids was continued at 3,000 cc. per day for the first six days. Following this she improved steadily, taking fluids by mouth and having daily bowel movements with the aid of enemas,

until July 26, two and one-half weeks later, when she developed a fever of 102°F. Upon vaginal examination a mass was felt in the pelvis, posterior to the uterus. Two days later, under ethylene anesthesia, a moderate-sized pelvic abscess containing colon bacillus pus was evacuated through the cul-de-sac. Since this infection must have occurred from the spill when the peritoneal coat split during the first operation, the surprising thing is that she did not get a general peritonitis or have earlier symptoms of the abscess. Following drainage of the abscess, she made a normal recovery and left the hospital on August 14, six weeks following admission, weighing eighty-four pounds. Upon examination July 10, 1940, one year later, the patient weighed 115 pounds and was in excellent health. She had no pain and no abdominal symptoms. The bowels were regular, there was no tendency to diarrhea and there were no nutritional disturbances. X-ray of the stomach following a barium meal, revealed normal findings.

Examination of the resected specimen showed that it consisted of nine layers of small intestine, that is, the intussusception was quadruple or "compounded" four times. It was 6 ft. 10 in. (205 cm.) long. There were no adhesions present between the layers of the intussusception and no evidence of tumor, polyp or other cause could be found, excepting that the mesentery was considerably longer than usual. There were large areas where the entire thickness of the wall was gangrenous, and the invaginated tissues were very edematous due to the long period of circulatory interference.

SUMMARY

1. Jejunal intussusception is largely found in adults. Its symptomatology is such that it can be diagnosed correctly preoperatively.

2. An additional case is reported, recurring in type, which necessitated a massive resection of 205 cm. of intestine.

3. No nutritional or metabolic disturbance has followed this resection.

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REGIONAL ENTERITIS*

REPORT OF TWENTY-ONE CASES

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REGIONAL enteritis—more often called terminal or regional ileitis—was first described in 1932 by Crohn, Ginsberg and Oppenheimer,¹ and later Pemberton and Brown,² Mixter,³ Homans,⁴ Jackson,⁵ and others have recorded their experiences with series of cases falling into this classification, and the more recent literature contains numerous series of cases, large and small, from all parts of the country. The purpose of this paper is to report our experience on the Surgical Service of the New York Hospital with this condition.

The classification of the cases of non-specific granuloma of the small intestine by Crohn and his co-workers was a distinct contribution in the field of medicine as it called attention to a clinical entity now recognized by physicians and surgeons alike. Prior to 1932 only occasional cases which could be fitted into this group were reported, thus imparting the impression that the disease either occurs more frequently now or is being recognized more often than in the past. In all probability, many of the lesions were incorrectly diagnosed and classified as tuberculous enteritis.

Whatever the reason, since 1932 several large series of cases have been recorded. Crohn himself⁶ up to 1938 had followed 110 cases personally; seventy-seven of these patients were subjected to operation. Pemberton and Brown² in 1937 reported thirty-nine cases from the records of the Mayo Clinic, and in thirty-six of these the diagnosis was substantiated by operation. In 1938 Mixter⁷ reported twenty cases, as well as a summary of information obtained through an extensive questionnaire in which data on 363 cases were obtained

from thirty-one individuals or clinics. Two hundred seventy-eight of these patients had been subjected to operation, with a mortality of 14 per cent and a recurrence rate of 20 per cent. The questionnaire revealed that the recurrences appeared within four months to six years. According to the collected opinions, radical resection in one or more stages was considered the treatment of choice in all but the acute stages of the disease.

In the earlier communications it was repeatedly stated that the lesion occurs chiefly in Semitics and is nonexistent in the Negro, this misconception arising from the fact that many of the series recorded came from hospitals caring chiefly for Jewish patients. In our series at the New York Hospital four out of twenty-one were colored and none was Jewish. Our statistics, however, confirmed those previously recorded in most other respects.

Since January 1, 1934, there have been twenty-one patients with regional enteritis admitted to the Surgical Service of the New York Hospital, thirteen of whom were females and eight males. Four Negroes were among the group. The disease was found most commonly in people in the third decade—eleven of our patients being between twenty-one and thirty years of age—the extremes noted being four and fifty-six years of age. The average age of all our patients were 27+ years. From this it appears that the age incidence of this condition corresponds with that of appendicitis, the disease with which it is most often confused.

Sixteen of our patients had had some complaints relative to the disease for over three months, four gave a history of three

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TABLE I

Case	History Number	Age	Sex	Duration of Symptoms	Pain	Diarrhea	Nausea and Vomiting	Weight Loss, Lbs.	Abdominal Tenderness	Abdom. Muscle Spasm	Palpable Abdom. Mass	W.B.C.	Hgb.	R.B.C.	Blood in Stools	X-ray Findings
1. I. T.	21081	31	F (C)	3 days	+	+	+	25	+	+	0	10,500	98	.....	0	None
2. M. T.	175385	21	F (W)	2 mos.	+	0	+	0	+	+	0	12,500	95	.....	0	None
3. W. I.	176060	28	M (W)	3 wks.	+	0	+	0	+	+	0	17,850	110	.....	0	None
4. L. J.	102614	26	M (C)	4 days	+	0	+	0	+	+	0	9,800	108	.....	0	None
5. F. R.	206145	22	M (W)	4 mos.	+	0	0	0	+	+	0	12,500	100	.....	0	None
6. I. C.	223802	24	F (W)	12 hrs.	+	0	+	0	+	+	+	11,000	75	3.8 M	0	+
7. J. S.	106614	25	M (W)	6 days	+	0	+	+	+	0	+	16,000	95	.....	0	None
8. E. M.	125099	37	F (W)	10 hrs.	+	0	+	0	+	+	0	10,300	73	4.0 M	0	None
9. G. L.	185432	4	F (W)	3 wks.	+	0	+	0	+	+	0	14,800	76	4.0 M	0	None
10. E. G.	205089	20	F (W)	3 mos.	+	0	+	0	+	0	0	11,500	85	4.0 M	0	None
11. R. H.	265060	31	M (W)	13 mos.	+	+	+	35	+	+	+	8,900	92	5.2 M	0	+
12. J. J.	66854	14	M (C)	3 mos.	+	+	0	0	+	+	+	9,000	55	3.2 M	0	+
13. D. W.	46690	27	F (W)	2 yrs.	+	+	+	+	+	0	+	12,800	70	3.5 M	0	+
14. C. T.	146351	27	F (W)	3 yrs.	+	+	+	20	+	0	+	8,000	70	3.3 M	+	+
15. L. H.	171391	43	F (W)	3 yrs.	+	+	+	50	+	0	+	4,000	91	4.7 M	0	+
16. A. G.	199487	26	F (W)	3 yrs.	+	+	+	mod.	0	+	0	8,100	62	4.0 M	+	+
17. M. V.	230682	29	F (C)	8 mos.	+	0	+	30	+	0	+	9,500	100	4.8 M	+	+
18. A. D.	230417	29	M (W)	10 mos.	+	+	+	20	+	0	+	10,000	96	4.8 M	0	+
19. M. M.	216121	36	F (W)	6 mos.	+	0	+	40	+	0	+	12,000	83	3.7 M	+	+
20. S. B.	240588	56	F (W)	4 mos.	+	+	+	20	+	0	0	15,100	90	5.0 M	+	+
21. S. H.	230454	14	M (W)	3 mos.	+	0	+	5	0	0	+	8,300	85	4.3 M	+	+

or more years' duration, and one patient had pain for only twenty-four hours before admission.

The one symptom common to all cases was cramping pain in the abdomen. Nineteen had had nausea and vomiting at some time in their illness, and in the cases of longer duration this complaint was especially important. Weight loss was admitted by twelve patients in most cases of from five to ten pounds, though of greater degree in the more chronic cases. In one case weight loss amounted to fifty pounds. Seven patients complained of diarrhea without blood being noticeable in the stools; none of our patients had external fistulae.

X-ray studies in the form of gastro-intestinal series and barium enemas were obtained in thirteen cases, leading to the diagnosis of regional enteritis or terminal ileitis in eleven. In two cases the x-ray studies were inconclusive, but the diagnosis was later proved at operation. The "string sign" was seen in six patients and was most easily visualized by means of barium enema. Alternate areas of dilatation and constriction of the small intestine were present in five patients.

ANALYSIS OF OPERATIONS

A summary of our operative procedures is found in Table II. There were twenty-four operations performed on twenty-one

TABLE II*

Operative Procedure	No. of Cases	Symptom Free	Unimproved	Postop. Mortality	Late Mortality
Simple exploration.....	2	1	1	0	0
Appendectomy.....	11	9	2	0	0
Resection with end-to-end anastomosis.....	4	2	2	0	0
Resection with lateral anastomosis.....	2	2	0	0	1 pt. died of carcinoma from ca. of cervix.
Resection with ileocolostomy (1 stage).....	2	2	0	0	0
Resection with ileocolostomy (2 stages).....	2	2	0	0	0
Enteroenterostomy.....	1	..	1	0	Pt. died of regional enteritis 6 mos. later.

* Twenty-four operative procedures performed on twenty-one patients.

On physical examination the outstanding finding was abdominal tenderness. This was present in 17 of our patients and was located predominantly in the right lower quadrant. Muscle spasm was found in nine patients; a mass palpable on abdominal examination was present in nine and by rectal examination in one. Slight to moderate distention was almost universally present. Occult blood was found in the stools of six of the eleven patients in whom this examination was carried out. The white blood count ranged from 4,000 to 17,000, the average being about 11,000. Five patients had hypochromic anemia with hemoglobin below 75 per cent. A low-grade fever was a common finding.

individuals without immediate postoperative mortality. Two of our patients on whom appendectomy was performed returned later for bowel resection, and one woman who had had resection performed suffered a recurrence, causing obstruction for which an enteroenterostomy was performed. One of our patients died at home nine months after resection from a recurrence of the disease, and one died six months after operation of metastatic carcinoma of the cervix.

Eleven patients presented a clinical picture simulating acute appendicitis with acute right lower quadrant pain, tenderness, muscle spasm and leukocytosis; two of these had a palpable mass. All eleven

were subjected to early operation and the terminal ileum was found to be reddened, thickened and hemorrhagic in each case. The mesentery was edematous and contained enlarged hyperplastic lymph-nodes and the operative procedure was limited to appendectomy and lymph-node biopsy. In the two cases with palpable masses there was no improvement until the patient was readmitted and radical resection was done. Eight of the ten of these eleven patients who have been followed are completely well six months to four years after operation.

It is usually stated that appendectomy should not be done in these cases since it predisposes to the formation of external fistulae, but to date we have not encountered this complication. On microscopic section the appendices presented an acute peri-appendicitis without mucosal involvement.

The group of cases subjected to radical resection presented symptoms suggestive of ulcerative colitis, with colicky pains, diarrhea (at times with blood and mucus), malaise, marked loss of weight, and in some instances fever. In addition, palpable masses and some degree of intestinal obstruction were found.

In four of the patients subjected to resection in which the lesion involved the terminal ileum exclusively, ileocolostomy and resection of the lesion was done either in one or two stages. All these patients have been well for from one to four years.

In the six remaining patients in whom a resection was done, a lateral anastomosis or an end-to-end anastomosis was done after varying lengths of jejunum or ileum had been removed. As much as 270 cm. of small bowel were removed in a fourteen year old boy, and 130 cm. have been removed in three other patients. Two of these six have not been aided by the procedure.

Two patients in this series were considered inoperable. In both, long segments of jejunum or ileum were involved and adherent to the rectum or bladder and their removal consequently were prohibited. One of these patients has subsequently recovered and the second to whom x-ray therapy was administered is unimproved.

CONCLUSIONS

Analysis of these cases suggests certain deductions as to the treatment of this condition:

1. A certain percentage of the patients with an acute condition will undergo spontaneous recovery or at least remain well for several years, the extent and duration of the recovery depending upon the amount of damage suffered by the bowel wall during the acute phase.

2. We must agree with previous reports that if improvement or a cure is to be anticipated in the patients with a chronic condition, a truly radical resection of bowel and mesentery must be done.

We have had insufficient experience in x-ray therapy to warrant any conclusions as to its effect.

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DYSCHONDROPLASIA OF THE DISTAL RADIAL EPIPHYSIS (MADELUNG'S DEFORMITY) WITH FUSION OF THE SEMILUNAR AND TRIANGULAR BONES*

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DYSCHONDROPLASIA of the distal radial epiphysis is an uncommon affection of the wrist. It results from a failure of development of the medial portion of the distal radial epiphysis, while the lateral part of the epiphysis continues to grow.

This abnormal growth causes a dorsal and lateral bowing of the radius and thus the articular face of the radius is turned ventrally and medially. Because of the ventral growth of the articular surface of the radius, the head of the ulna appears prominent on the dorsum of the wrist, and the first impression is that one is dealing with a posterior displacement of the head of the ulna. A typical "bayonet" deformity of the wrist is present, giving the appearance of a central luxation of the wrist.

This deformity is usually bilateral, (128 out of 172 cases), and is found more frequently in females (4 to 1). A few rare "reverse" types have been reported—five in all.

Madelung first reported the condition in 1878. Since that time the majority of reports in the literature have appeared in foreign publications. Anton et al.¹ reviewed the entire literature to date, critically analyzing each published report. Some reports they discarded as not typical, or the condition described was due to injury, or the report was too incomplete to be acceptable. They entered into an exhaustive discussion of etiology, symptomatology and characteristic features. With their case report a total of twenty-one such deformities

had been reported in the literature of this country. The reader is referred to this article for a review of the factors that make up this disease.

Thompson and Kalayjian² report five typical cases, one of which had a deformity at the elbow, in that the head of the radius was atrophied and distracted from the elbow.

Dannenberg et al.³ report a case. They list twelve roentgenographic diagnostic criteria that should be met before the term dyschondroplasia of the distal radial epiphysis, as suggested by Anton et al., is applied.

Ghormley and Pollock⁴ report the case of a woman, aged forty-two, in whom the deformity was bilateral, with a bilateral dislocation of the heads of the radii. The patient had an elder sister with a similar deformity. The patient's fifteen year old daughter's wrists had been thus deformed for two years. A nine year-old daughter had not yet shown any deformities.

These reports bring the total of cases recorded in the American literature to twenty-eight. The following case of the authors' supplements this surprisingly small number, as well as adding an anomaly of the carpus not previously reported, although a fairly high frequency of other developmental abnormalities is reported.

CASE REPORT

Case No. D2088, M. McF., a colored female, age thirty, employed as a maid, first consulted one of the authors because of complaints of

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soreness in her left wrist and arm. She stated that on March 7, 1940, while working at her place of employment, she was washing a heavy

not remember at what age she first noticed this prominence.

Physical examination revealed a colored,

FIG. 1.



FIG. 2.



FIG. 1. Anteroposterior roentgenograms of both wrists.

FIG. 2. Posteroanterior roentgenograms of both wrists.

iron stove burner. The burner slipped and struck her left wrist. She said this left wrist became sore that afternoon.

Past History. She was born and had lived in Texas until the age of twenty-six, when she came to California. She could remember nothing unusual about her childhood. She had mumps but no other childhood diseases and had had no other illnesses, accidents or injuries of any kind. She went to school through the seventh Grade. She said she did no work of any heavy nature until she began to do housework outside her home at about twenty-two to twenty-three years of age, and had been doing housework since. She was married at twenty-five but was never pregnant. She denied any trouble with any of her joints at any time. She said she had always noticed a prominence of the bones on the back of her wrists, but could

underweight female, apparently in no distress. Her temperature was 98.6°F.; pulse 120, blood pressure 142/86. Pupils were equal and regular and reacted to light and accommodation. The patient's nose was open; ears were filled with wax and drums were normal. Her teeth were in good condition, tonsils moderate in size, neck normal and thyroid not palpable. Her breasts were pendulous but there were no masses. Chest was normal to percussion and auscultation; heart was normal in size and no murmurs were present. The abdomen was scaphoid; liver and spleen were not palpable and there were no masses. A pelvic examination was not done. The lower extremities were normal.

There was a full range of active motion of both shoulders, elbows, all fingers and both thumbs. There was nothing abnormal about the upper extremities except the wrists. Both

wrists showed abnormal prominence of the heads of the ulnae, in all positions and to an equal degree. There was no swelling or thickening of soft tissues, or increased local heat. There was a tendency for both hands to be in some ulnar deviation, with the appearance of anterior luxation of the carpus. Active motions of the wrists were as follows:

	Left, Degrees	Right, Degrees
Flexion.....	58	60
Extension.....	31	40
Ulnar deviation.....	41	41
Radial deviation.....	0	0

There was full supination and pronation of both forearms. The circumferences of the arms were as follows:

	Left, Inches	Right, Inches
Biceps, flaccid.....	8½	8½
Biceps, contracted.....	9½	9½
Forearms.....	7½	8½

The patient was right-handed.

Laboratory Report. 80 per cent (13.5 Gm.) hemoglobin (Sahli); 4,020,000 red blood cells; 9,350 white blood cells. Differential: polymorphonuclears 36 per cent, lymphocytes 53 per cent, large mononuclears 8 per cent, eosinophiles 2 per cent; basophiles 1 per cent. Urinalysis of voided specimen: Straw color, alkaline reaction; sugar negative, albumin negative, acetone negative. Microscopic: 8 to 10 pus cells per high dry field. Blood Wassermann, Kahn and Laughlen tests, all 4 plus. Basal metabolic rate, plus 9.6.

Roentgenograms were made of both wrists in anteroposterior, posteroanterior, and lateral positions (Figs. 1, 2 and 3) and were interpreted as follows:

There is a bilateral deformity of both radii and wrists. There is an abnormally increased medial and ventral rotation of the articular faces of both radii. There is a prominence of the heads of both ulnae on the dorsum of the wrists. The carpal bones extend ventrally to meet the metacarpals which lie in the same

plane as the bones of the forearm, making a bayonet-like deformity. There is noticed on the medial side of both radii, where they articulate



FIG. 3. Lateral roentgenograms of both wrists.

with the heads of both ulnae, an atrophic area where bone has failed to develop. Just above this area on both radii is a small spur. This deformity is due to a failure of proper growth of the medial half of the distal radial epiphysis and is known as dyschondroplasia of the distal radial epiphysis, or Madelung's deformity. There is noted a fusion of the semilunar and triangular bones bilaterally.

Treatment. No treatment for the deformity in this instance was indicated. Osteotomy usually of the cuneiform type has been advised when a correction of the curvatures of the radius is desirable.

SUMMARY

The writers have presented a case of bilateral dyschondroplasia of the distal radial epiphysis (Madelung's deformity) with fusion of the semilunar and triangular bones.

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MANAGEMENT OF TRAUMATIC MENINGITIS

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SULFONAMIDE therapy has been extremely effective in the management of meningitis. While the literature is large and still growing as concerns nontraumatic cases, there are very few articles on the subject of management of traumatic meningitis with sulfonamide derivatives. Allan, Mayer and Williams report on three cases of pneumococcic meningitis with recovery. One case was traumatic in origin. Finland, Brown and Raugh discussed ten cases of pneumococcic meningitis with three belonging in the traumatic group. All three patients recovered. Elvidge and Roseman discussed a case of recurrent traumatic pneumococcic meningitis with recovery. Neal, Appelbaum and Jackson describe thirty cases of pneumococcic and twenty-nine cases of influenzal meningitis. In the pneumococcic group there were three traumatic cases. Two of the three patients died. Ricard, Larget and Giraud described a single case of traumatic streptococcic meningitis with recovery, and a similar case is described by Narat. In summary, there are eight cases of pneumococcic meningitis and two cases of *Streptococcus hemolyticus* meningitis. In this group of ten cases there were two deaths, both in the pneumococcic group.

In the next few paragraphs three cases of traumatic meningitis will be reported briefly. In two, *Streptococcus hemolyticus* was isolated from the spinal fluid. In the third case, although no organisms were isolated and there was no growth on culture media, recovery with the use of sulfanilamide was spectacular. A brief résumé of the management of the patients is as follows:

CASE REPORTS

CASE I. S. R., age fourteen, entered Redford Receiving Hospital in an unconscious state

following a bicycle accident on July 7, 1938 and was later transferred to Grace Hospital where he remained from August 1, 1938 to August 23, 1938. He had profuse bleeding from the right ear and cerebrospinal fluid discharge lasting about ten days. Five days after entrance he had an increase in temperature to 103°r., rigidity of the neck and some rigidity of all extremities. Spinal fluid revealed 3,600 pus cells per cubic millimeter. Hemolytic streptococci and some gram-negative bacilli were grown on culture.

The patient was given 80 gr. of sulfanilamide with sodium bicarbonate daily by mouth for two weeks. At times the drug was withheld for a day and a half to two days because of its unfavorable reaction on the patient. During his stay in the hospital he was given four blood transfusions, a total of 1,250 cc. of whole blood being given. Lumbar punctures were performed every day at first and every second and third day later. A high sulfanilamide level of 20.4 mg. per 100 cc. of blood and 17.2 mg. of spinal fluid was reached in the second week. The last spinal fluid examination, August 17, 1938, revealed twenty cells and the patient's condition was satisfactory. Since that time patient has done very well except for some conductive deafness of the left ear. The child seems to have no sequelae.

CASE II. N. B., age twenty-nine, entered Receiving Hospital on July 22, 1939 and was discharged on August 12, 1939. She was injured in an automobile accident following which she remained comatose for several days. There was bleeding from both ears. On the fifth day after entrance, July 27, 1939, the patient's temperature rose to 104.2°F. and at the same time there was rigidity of the neck and a positive Kernig reaction. The patient became somewhat irrational. The spinal fluid was cloudy with a slight yellow tinge and contained 4,600 polymorphonuclear cells. A total of 120 gr. of sulfanilamide with sodium bicarbonate was administered daily for ten days. No organisms were found on smear but on culture hemolytic streptococci were grown. The patient had several lumbar punctures with slowly receding

cell counts until on August 2, 1939 there were eight white blood cells per cubic millimeter. The sulfamilamide level ranged between 12.4 and 5.8 mg. per 100 cc. of blood. In one instance the spinal fluid sulfanilamide level was found to be $3\frac{1}{2}$ mg. per 100 cc. The patient was given 500 cc. of blood on July 29, 1939 because of a secondary anemia (Hgb. 8.5, R.B.C. 2,870,000). She became improved clinically on August 6, 1939 and was quite asymptomatic on August 10, 1939. The drug was discontinued on August 8, 1939. During her illness the presence of bilateral sixth nerve paralysis was noted and she has shown no improvement up to the present time (October, 1940). This bilateral sixth nerve paralysis preceded the meningitic infection.

In the next case the usual findings of meningitis, namely, polymorphonuclear infiltration of spinal fluid, rigidity of the neck, increase in temperature were noted. However, on culture no organisms were grown. In this case there was a rather definite change in the symptomatology following the administration of the drug. Whether he was treated before normal growth of the organisms or whether this case represents an anaerobic type of streptococcus is a question. It is here reported because granted a patient with sudden increase in temperature associated with rigidity of the neck and a spinal fluid cell count of 2,000 or more pus cells per cubic millimeter, treatment has to be instituted whether organisms are found or not. If the instituted treatment happens to be followed by satisfactory results, it is reasonable to consider it partly responsible for the recovery.

CASE III. J. P., age thirty-one, colored, entered the Receiving Hospital November 22, 1939 and was discharged January 1, 1940. The patient was admitted to the hospital after an effort to commit suicide by shooting himself. The wound of entrance was in the right anterior temporal region and the point of exit at the midforehead about one and one-half inches above the brow line. There was marked comminution and fragmentation of bone involving

the right forehead. The patient was operated upon and fully two ounces of frontal lobe was found necrotic and destroyed. This was sucked away. The dura was badly torn in many directions but after the removal of the portion of the frontal lobe it was possible to effect some semblance of repair of the dural lining. Both frontal sinuses were badly comminuted and they were removed. The sinus as well as the dura were packed with iodoform gauze and the incision was closed in layers. Seven days after entrance into the hospital the patient developed a rigidity of the neck and a fever of 103.6°F . Lumbar puncture was performed which showed a turbid fluid with 4,800 W.B.C. (100 per cent polymorphonuclear cells). No organisms were found either on smear or culture. The patient was given 120 gr. of sulfanilamide with sodium bicarbonate daily for seven days. There was marked improvement in his condition clinically after the second day. Thereafter his temperature remained somewhat elevated for about one week although he seemed normal clinically. Blood sulfanilamide level ranged between 8.9 and 11.7.

COMMENT

In the management of head injury a complicating meningitis should be sought for as early as possible. At the onset of symptoms and signs, a lumbar puncture should be performed to study the spinal fluid, and if the latter is turbid and cloudy treatment with sulfanilamide should be instituted immediately. An initial dose of 40 gr. in the adult followed by 20 gr. every four hours can be given along with 2 teaspoonsful of sodium bicarbonate with each dose. Careful microscopic examination for the presence of organisms should be made. If the organisms are found, they should be classified and the treatment should be instituted based upon the type of infection. At the present time with the use of sulfonamide therapy streptococcic, staphylococcic, pneumococcic and meningococcic infection of the meninges may be treated successfully in most instances. If no organisms are found in the spinal fluid, sulfanilamide should be continued. While the patient is given the drug the spinal fluid

can be cultured for organisms. If on culture no organisms are found and if the administration of the drug has been followed by evidences of improvement, the drug is continued for many days, usually a week to ten days. Lumbar puncture every one to three days, daily white blood count, red blood count and sulfanilamide level of blood and if possible of the spinal fluid are in order. If secondary anemia supervenes a transfusion of whole blood or plasma may be given. Each of the three patients reported were given transfusions of whole blood during the course of their treatment. In the case of S. R., age fourteen, five transfusions of 250 cc. were given over a period of two and a half weeks.

In the above three cases, two adults and one child, 80 to 120 gr. of sulfanilamide were given daily. The drug was given orally most of the time. On occasions it was administered in saline, the drug going into a 1 per cent solution. Sodium bicarbonate was also given to combat acidosis. In these cases it was not necessary to inject the drug intravenously or into the spinal subarachnoid space. Probably none of them were allowed to go too far before the infection was noted and before the patients became moribund. Hence, it was possible to give the drug by mouth almost throughout the treatment. The blood sulfanilamide level was over 10 in all three cases tested. In Case I a high of 20.4 mg. per 100 cc. was noted on the sixth day. The spinal fluid sulfanilamide level was high in Case I (17.4) and rather low in Cases II and III (3.4 and 8.9). The clinical course of the patient seems more important than the sulfanilamide level of blood or spinal fluid in the treatment of traumatic meningitis. If the patient is carrying on satisfactorily and the usual dose of sulfanilamide is given, it is not necessary to become panicky because the drug level is too low. One reason for lower than actual levels may be the time at which the fluids are obtained in relation to the last dose of the drug, for the latter is easily excreted through the kidneys.

In the above reported cases two of the patients were proven to be infected with hemolytic streptococci. No organisms were isolated or grown on culture in Case III. That there was a meningitic infection and that the administration of sulfanilamide was followed by remarkable improvement in the clinical condition of the patient, there can be no doubt. Lack of growth on the culture media may have been due to the anaerobic qualities of the organism, or the early administration of the drug may have thwarted the growth of the offender.

It is not believed that a routine administration of prophylactic doses of the drug is proper; it may even be dangerous. One has ample time to treat the patient when symptoms and signs of meningitis supervene.

A word of caution is pertinent concerning the proper management of conditions in head injury to obviate intracranial infection insofar as possible. The proper treatment of lacerations of the scalp, compound fractures, bleeding ears, pneumocephalus, cerebrospinal fluid rhinorrhea are in order. The fact that sulfonamide therapy is efficacious does not excuse improper management of cases of head injury.

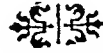
SUMMARY

1. Three cases of traumatic meningitis treated with sulfanilamide are reported.
2. With early recognition of meningitis based on clinical and spinal fluid findings, sulfonamide therapy should be instituted at once. Oral administration of the drug is satisfactory.
3. The proper management of lacerations, compound fractures, blood and cerebrospinal fluid leakage from the ear and nose will obviate intracranial infection in the greatest majority.
4. Routine administration of the drug is improper and it may be dangerous.

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IN all paralyzed muscles the circulation is very poor and frequently the limbs become cold and almost purplish in color. The use of supervised muscle training in the after-care of poliomyelitis, therefore, is the most important part of the treatment in restoring, partially or wholly, the function of the muscles. This can be made more effective if the circulation is good and the limbs are kept warm; massage can promote good circulation.

PYLEPHLEBITIS: RESPONSE TO SULPHANILAMIDE

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THE widespread practice of early operation in acute appendicitis has made pylephlebitis, never very frequent, one of its rarest complications. Its incidence has been variously reported from 0.1 to 0.4 per cent. The rarity of portal phlebitis, associated as it is with metastatic liver suppuration, has been extremely fortunate since its surgical therapy has met with little success. Prophylactic ligation of the ileocolic vein beyond the point of thrombosis has accounted for some successful cases,¹ but portal vein ligation when the process has become further advanced has been uniformly fatal. The bactericidal properties of the liver have, in overcoming septic emboli, accounted for a few cases with spontaneous cure. Indeed, thrombosis in advance of the inflammatory process by sealing the hepatopetal vessel may also be a factor in checking the process. Early surgical drainage of accessible confluent liver abscesses has brought results in other cases, but in most cases multiple, small diffusely scattered abscesses are quite beyond the scope of surgical treatment. Thus, while not absolutely futile, the surgical therapy of pylephlebitis has been generally inadequate.

As a forerunner of greater success in treatment is the appearance of reports of a few cases in which the patients have completely recovered with sulphanilamide (Ottenberg and Berek,² Graham³). The actual value of any drug can be determined only after its prolonged trial in a great many cases. Because of the infrequency of the disease and since the drug has been in use only for the past few years, the accumulation of successful case reports will be slow. Indeed, this report was delayed in the interest of accumulating several cases, but this hope was not fulfilled. The purpose of

this paper is to report, therefore, one additional case and to emphasize the apparently successful rôle of sulphanilamide in its therapy. The response to sulphanilamide is not surprising since the micro-organisms usually involved are colon bacilli and streptococci, both of these bacteria are generally susceptible to the action of the drug.

CASE REPORT

S. B., aged sixty-four, a white, male, appeared on the surgical service of Dr. Paul W. Aschner at the Jewish Hospital of Brooklyn on June 29, 1938, with the chief complaint of generalized abdominal pain of five days' duration. He gave a history of having been treated for a peptic ulcer for twenty years corroborated by x-ray examination. He had a suprapubic prostatectomy ten years before and a hemorrhoidectomy two years previous.

Five days before admission the patient was suddenly seized with severe periumbilical cramps. The pain persisted and was aggravated by an enema taken two days later. There was no nausea nor vomiting until the night before admission when it became continuous. There was no hematemesis or tarry stools. Nonbloody diarrhea appeared two days before admission and occurred five to ten times daily. He ran a fever as high as 102°F. There was no history of any chills.

On physical examination the temperature was 101°F., pulse 92, blood pressure 160/84. The patient appeared acutely ill and was hiccupping and vomiting. There was moderate abdominal distention. The right lower quadrant was exquisitely tender with spasm, rebound tenderness and sensation of a mass. There was moderate tenderness in the upper quadrants. Borborygmus was absent on abdominal auscultation. The blood count on admission was as follows: white blood cells 10,200, polymorphonuclear leucocytes 74, lymphocytes 22, monocytes 4, hemoglobin 94 per cent, red blood cells 5,300,000. The urine showed a two plus

albumin with occasional casts. The diagnosis was acute appendicitis with local abscess. Perforated peptic ulcer was considered in the differential diagnosis. The former diagnosis was favored and operation was performed shortly after admission.

A right lower rectus incision was made and upon opening the peritoneal cavity, there was an escape of free, turbid fluid with flakes of fibrin and a foul odor. In the right lower quadrant, an inflamed, thickened, granular portion of omentum overspread several loops of small bowel and cecum, the bowel being covered with plastic exudate. On separating the omentum, several pockets of thick pus were encountered. The appendix was black, gangrenous, collapsed and as thin as tissue paper. The appendix ran downward over the pelvic brim and was adherent deep in the true pelvis.

The appendix was mobilized, the meso-appendix ligated and appendectomy performed without stump inversion. One cigarette drain was placed in the pelvis and one iodoform gauze pack at the appendiceal site.

Microscopic examination of appendix revealed the following: All the coats of the organ were the seat of a diffuse suppurative infiltration. Scattered throughout were numerous areas of necrosis. In the serosa, some of the vessels were filled with purulent thrombi. (Fig. 1.) A smear of the pus from the peritoneal cavity revealed gram-negative bacilli and gram-positive diplococci and streptococci. Bacilli pyocyanus and streptococci were grown out on culture.

The patient ran a stormy course for the first week following which the temperature dropped to 100°F. The drains were removed on the seventh postoperative day and profuse drainage persisted for an additional week. On the tenth postoperative day the patient's temperature began to spike to 103°F. and at that time it was noted that the patient was jaundiced. The icteric index was 66 and bile was present in the urine. The liver and spleen were not palpable at any time. There was no tenderness over the liver but edema was present over the tenth and eleventh intercostal spaces in the posterior axillary line. On the twelfth postoperative day the patient was started on 80 gr. of sulphanilamide. Within forty-eight hours the temperature flattened to between 100 and 101°F. After nine days of sulphanilamide therapy, which was gradually decreased to 40 gr. daily, the temperature became normal

and remained so for the week prior to the patient's discharge. Blood chemistry, taken three days after the onset of the sulphanilamide

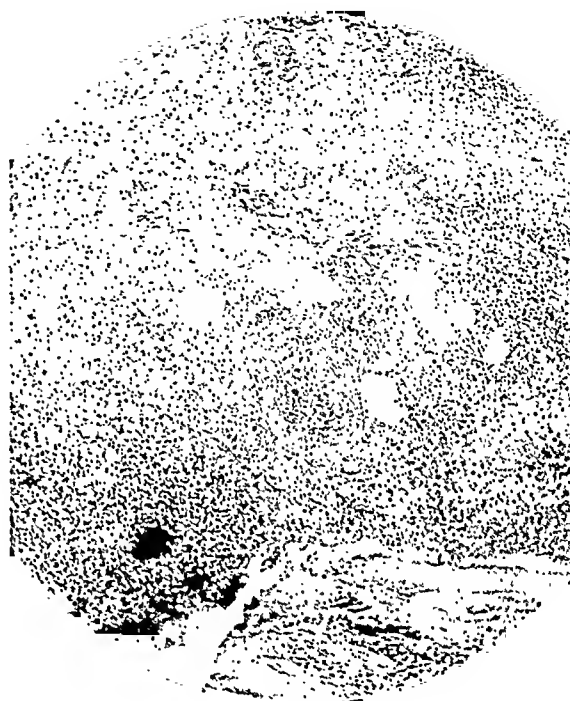


FIG. 1. Microphotograph of section of appendiceal scrosal vessel filled with purulent thrombus.

therapy, showed the icteric index to be 18.7 with a delayed direct Van den Bergh. Total cholesterol was 119 with 71 per cent cholesterol esters. The jaundice rapidly cleared so that it was no longer discernible on discharge.

COMMENT

There can be very little doubt that this was a case of suppurative pylephlebitis with metastatic liver involvement. The diagnosis is purely clinical and has not been proven by laparotomy or liver biopsy. However, the case presents the clinical appearance and the physical and laboratory findings to warrant this diagnosis. The microphotograph of one of the appendiceal scrosal vessels filled with a purulent thrombus is cogent testimony to the focus of the infection. Indeed, the rapid response to sulphanilamide would seem to give added weight to the nature of the pathologic process in this case, as compared to the injurious effect it would have in a case of toxic hepatitis.

SUMMARY

This is a report of a case of pylephlebitis with liver involvement secondary to appendiceal thrombophlebitis. The case is added to the literature as an additional instance of successful sulphanilamide therapy. There does not appear to have been

any reports of failure of this therapy, so that it is possible that in sulphanilamide we have a potent weapon against a hitherto fatal disease.

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Obesity is one of the most serious hurdles in the path of the poliomyelitic person. Many patients become obese from lack of activity or of diversion of thought, or possibly from stimulation or irritation of certain glands of internal secretion which are involved in growth and development . . . Weight reduction is accomplished by diet, exercise, endocrine therapy, and adequate intestinal elimination.

The brief excerpts in this issue have been taken from "Infantile Paralysis: Anterior Poliomyelitis" by Philip Lewin (W. B. Saunders Company).

HEMIPLEGIA FOLLOWING SPINAL ANESTHESIA*

REPORT OF A CASE

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INTRODUCTION

THOUGH the recent literature on neurological sequelae of subarachnoid block is quite voluminous, there are very few reports on hemiplegias following this type of anesthesia. Our search of the medical literature of the past five years reveals but seven articles¹⁻⁷ dealing with this subject. Out of those seven articles, only two (both American authors) make the attempt to present their cases in the light of a modern conception of the etiology of such complications. Therefore, we believe that our case merits reporting, not only for its relative rarity, but also for an opportunity to restate this new interpretation of causative factors.

CASE REPORT

Mrs. G. V., age forty-three, a white, native American, on November 22, 1938, was admitted to the private service of Dr. Fisher with a complaint of meno- and metrorrhagia of three years' duration. For the past five months she had noticed increasing weakness and fatigue. Her family and past history were essentially negative except for diphtheria in early childhood and two attacks of rheumatic fever at six and seventeen years of age without any known complications. Systemic review was negative. Menses began at twelve years of age. She was married at eighteen years and had no pregnancies. Physical examination: pulse 64, respirations 20, temperature 99.2°F., blood pressure 138/80. The patient was a fairly well developed and well nourished woman of middle age who gave the impression of being chronically ill. Skin and lips were very pale, so were the conjunctivae and the mucous membranes of the mouth. Otherwise the physical

examination was essentially negative. *Laboratory data:* urine negative except for one plus albumin. *Blood:* hemoglobin 46 per cent, erythrocytes 3,250,000, leukocytes 6,000 (neutrophils 81 per cent, lymphocytes 18 per cent and eosinophiles 1 per cent). Red blood cells showed a marked central pallor, some polychromatophilia and moderate poikilocytosis and anisocytosis. Serology was negative. The diagnosis was fibroid uterus with secondary anemia. After two transfusions (November 23 and 25) amounting to 875 cc. her hemoglobin rose to 81 per cent and the erythrocytes to 4,370,000. Both times the indirect method was used and there was moderate reaction following the second transfusion.

She underwent operation on November 28, when a supracervical hysterectomy with appendectomy was performed. The operation lasted forty minutes and the patient left the operating room in good condition save for a low blood pressure of 60/45. The anesthetic consisted of a mixture of 150 mg. of neocaine with 1.5 mg. of 1:200 nupercaine solution injected into the fourth lumbar interspace. The spinal tap did not present any technical difficulties. The only untoward result noticed during the operation was a severe drop in blood pressure immediately after the injection of the anesthetic mixture. The pressure fell to 70/40 and the patient began to show signs of moderate spinal shock manifested by pallor and persistent nausea. To counteract these symptoms the patient received a continuous inhalation of oxygen. No vasoconstricting agents were used at any time before or during the operation. The pressure remained extremely low throughout the operation: 70/45, 60/45 and 55/45. The preoperative medication consisted of 1½ g. of phenobarbital the evening preceding the operation and one tablet of HMC #1 (morphine sulphate gr. ¼, hyosine hydrobromate gr. ¼₁₀₀ and eactoid gr. ¼₆₀) one hour and a half

* From the Surgical Division of St. John's Hospital, Brooklyn, New York. John E. Jennings, M.D., Chief of Service. Read before the Monthly Meeting of the Professional Staff of St. John's Hospital, February 4, 1941.

prior to operation. At no time did the patient show any signs of being oversedated.

Postoperative Course. It was noticed the following day that the patient had not spoken since the operation. In addition, it was observed that she did not move her right side. One day later she began to show signs of a facial paralysis on the right side. On the same day (November 30) she was seen by Dr. Bondar in a neurological consultation. His findings were as follows: "History of long standing secondary anemia from loss of blood. At present patient has complete aphasia, moderate sensory right-sided hemianesthesia and analgesia and flaccid right-sided hemiplegia with Babinski, Chaddock, Oppenheim and Schaefer on the right. Cranial nerves are all normal except right central facial weakness with drooling from the right side of the mouth and sensory changes over the right side of the face. Left fundus visualized—disc within normal limits. Right disc not seen. Although patient is conscious and apparently alert, there is no response to questions or commands. Impression: Cerebral thrombosis left hemisphere involving supra-marginal gyrus, pre- and post-Rolandic gyri. In view of the progressive signs prognosis is extremely guarded." On the following day (December 1) in addition to her other signs, patient had a stiff neck. However, she seemed to be somewhat brighter and was trying to speak. During the following week her condition remained practically unchanged except that on the seventh day she was able to take fluids through a glass tube held in the right side of the mouth.

On December 6 she underwent another neurological examination by Dr. Feinier, whose findings were essentially similar to that of Dr. Bondar. Dr. Feinier believed that the patient had suffered a vascular accident, a thrombosis of a branch of the left middle cerebral artery. He also thought that the patient was improving. On December 13, the patient was again seen by Dr. Feinier, who noted the following progress: "Patient is now able to speak—is able to repeat words and can talk spontaneously. No movements have been noted in right upper extremity. The right facial is slightly less pronounced. Right Babinski positive. Right-sided deep reflexes present. Responds to pin-prick on the right."

The progress of her recovery was very slow. She was able to move her arm on December 16.

The sign of Babinski was gone on the twentieth. On December 24 she was able to take a few steps. On the twenty-seventh she walked to the bathroom and was able to flex and to extend fingers of right hand. After a forty-eight day hospital stay she was discharged on January 15, 1939, as improved with right hemiplegia and aphasia still present. At present her condition is practically normal except for marked changes in her personality. Instead of being a very capable, energetic woman, occupying a responsible position, she shows now many childish traits. Her intelligence has undergone considerable retrogressive changes and she is entirely dependent at the present time.

GENERAL COMMENT

Hitherto, the usual approach to the neurological sequelae of spinal anesthesia has been made from three fundamental standpoints in regard to their etiology, namely, infection, trauma and the toxicity of the drug. For the majority of such cases this interpretation has been found sufficient to explain the pathology and to account for the clinical manifestations of such complications as the syndrome of the cauda equina or conus medularis, myelitis, aseptic meningitis and meningoencephalitis. But it was much more difficult to explain on such grounds complications that dealt with cerebral damage only, and where at no time were any indications of an involvement of the spinal cord or its meninges found. It is at the present time generally accepted that the cerebral complications of inhalation and even local anesthesia are the result of an anoxia occurring during the time of anesthesia.^{8,9} The anesthetic agent per se has nothing to do with them. A similar interpretation for the purely cerebral complications of spinal anesthesia must be admitted. That such an approach is debatable is shown by the fact that both neurologists, who have seen our case, have expressed their opinion that a thrombosis was the cause of this accident. We question this diagnosis and suggest a selective anoxia of the brain as the cause of a focal necrosis of the cortex.

The damaging rôle of anoxemia and tissue anoxia so often associated with spinal anesthesia is still insufficiently stressed. Moreover, it is insufficiently understood. For a better elucidation of our point of view a brief discourse on some fundamental physiological and pathological manifestations of spinal anesthesia is in order. Profound circulatory and respiratory changes take place in spinal anesthesia.¹⁰ A loss of the skeletal muscle tone and the paralysis of the vasoconstrictor nerves of the anesthetized area result in an increased vascular bed. This leads to a low blood pressure, diminished minute volume flow of blood and poor oxygenation of the tissues. Circulation time becomes greatly increased¹¹ and the condition of stagnant anoxia results.¹² Inasmuch as the integrity of the brain and heart is closely interwoven with an adequate supply of oxygen, an insufficient flow of blood through central respiratory mechanism secondary to cardiovascular depression may spell disaster, even without the necessity of an actual respiratory or cardiac failure. A paradoxical asphyxia of the tissues can develop even in the presence of an abundant supply of oxygen if the depth of respiration is insufficient to effect washing out of carbon dioxide from the venous blood. In the cases which came to necropsy, embolism or hemorrhage very seldom were found and the histological changes in the brain were strikingly similar to those found in animals subjected to death from asphyxia. These changes also bore a close resemblance to the lesions found in asphyxia after general anesthesia and consisted mainly of areas of focal necrosis of the cortex. The alteration in the globus pallidus were more pronounced after spinal anesthesia.¹³ The unilateral brain damage such as is observed in hemiplegias can be explained on the grounds of extremely common individual variations in the pattern of the vessels arising from the circle of Willis and supplying the two halves of the cerebrum.¹⁴ The cells of the cerebral cortex exhibit not only a peculiar sensitivity to the lack of oxygen but also a peculiar tendency

to degeneration of certain layers. This is probably due to the local disturbances in the cerebral circulation: the poorer the blood supply, the greater the degree of cellular damage.¹⁵

While practically in every spinal anesthesia we encounter a drop in blood pressure with associated anoxia of various degrees of intensity, the question arises why such postspinal encephalopathy does not occur more frequently. The answer lies in the complexity of the causative forces involved. Anoxia produced by spinal anesthesia is but the final precipitating factor.

At least two additional factors deserve consideration, namely, a histotoxic anoxia and a latent impairment in cardiocirculatory efficiency. In histotoxic anoxia the cells are so damaged that utilization of oxygen becomes greatly handicapped. The main cause of such catabolic type of anoxia is excessive use of preoperative medications. This factor is especially stressed by Schreiber¹⁶ who is greatly impressed by the number of cases of altered personality following spinal anesthesia. He attributes such cerebral degenerative changes to the excessive use of such histotoxic agents. It is quite obvious that superimposition of the stagnant anoxia of spinal anesthesia on existing histotoxic anoxia may spell disaster in certain cases.

As to the factor of latent impaired cardiocirculatory efficiency, its importance in the cerebral complications following all types of anesthesia is greatly emphasized in the recent papers by Behrend and Riggs.¹⁷ In such conditions as organic heart disease, anemias, metabolic disorders such as diabetes mellitus or hyperthyroidism, a chronic circulatory inefficiency may exist which under ordinary circumstances gives no clinical evidences of its presence. Under the added stress of spinal anesthesia, with its great demand on the reserve power of the cardiovascular system—for that matter any additional demand on this system—a circulatory breakdown may take place and precipitate cerebral changes, such as psychoses, convulsions, paralysis or even death.

In our cases, all the aforementioned factors were present: chronic anemia, heavy premedication and severe drop in blood pressure following spinal anesthesia. In addition, the patient being a redhead, even a peculiar vasomotor make-up may be suspected.

SUMMARY

A case of a right-sided hemiplegia with aphasia following spinal anesthesia is presented and the rôle of stagnant anoxia as the precipitating factor of such a complication is discussed.

I wish to thank Dr. S. Lloyd Fisher for his permission to report this case.

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TRAUMATIC RUPTURE OF NORMAL SPLEEN WITH DELAYED HEMORRHAGE

REPORT OF A CASE

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THERE is a marked difference of opinion concerning the relative frequency of traumatic rupture of the spleen. Mazel¹ reports that rupture of the spleen occurs in 30 per cent of subcutaneous injuries to the abdominal viscera. Bronaugh² reports 33 per cent, Wright and Prigot³ and Connors⁴ show that the spleen is involved in 47.6 per cent of cases of pathologic conditions of the viscera due to subcutaneous injury.

The automobile is the traumatic agent in the greatest number of cases. Falls are second in frequency. In the age group the incident is greatest in children up to the age of ten and then in the final age group from forty to sixty.

Wright and Prigot³ divide the cases into five clinical types dependent upon the rate of hemorrhage: (1) Massive hemorrhage, causing immediate or sudden death; (2) acute hemorrhage, producing shortly after the injury a state of shock which rapidly becomes deeper; (3) repeated small hemorrhages. The patients enter the hospital in good condition but show signs of slow, progressive hemorrhage, increasing anemia, a rising pulse rate, fall in blood pressure and progressive weakness. (4) Late hemorrhage. The patients have an initial injury from which they recover. After a period of relief from symptoms they suddenly go into shock, showing signs of acute internal concealed hemorrhage or they may have a recurrence of signs and symptoms of repeated small hemorrhages. They may gradually become worse, showing signs of increased hemorrhage over a period of days or weeks. (5) Spontaneous cure. The pa-

tients show no signs of hemorrhage and suffer only localized pain, which soon disappears. The only one of these groups with which we are concerned in this paper is the late hemorrhage, as the case reported falls into this class.

In this group of cases the period of symptomatic relief is called the latent period. This period is terminated by some minor incident, such as straining at stool, or a muscular spasm, or for no apparent reason as in our case. The second hemorrhage may not show the acute symptoms of blood loss but may have a slow insidious onset.

CASE REPORT

A white male, fifty years of age, had engaged in an altercation and a physical examination made immediately afterward revealed tenderness over the tenth rib at the left anterior axillary line and a contusion of the skin on the right side of the chest. Fluoroscopic examination of the chest revealed no abnormal findings. The injury was then considered a bruise to the soft tissues and not serious.

The patient was symptom free for six days following this incident. On the seventh day the patient became acutely ill. Observation revealed him to be lying in bed and in an apparent moderate amount of pain. He complained of pain in the epigastric region, the left shoulder, left arm and the left side of the neck. The essential physical findings were as follows: The abdomen was flaccid, but there was a definite point of tenderness in the epigastric region. Codeine gr. $\frac{1}{2}$ and aspirin gr. 5 were administered and an s.s. enema given following which the patient appeared to be more comfortable and went to sleep. Three hours later the patient had an emesis of clear vomitus follow-

ing which he went to sleep. Symptoms of acute distress became manifest five hours later. Examination at this time revealed the abdomen

very large amount of dark red blood. Examination of the spleen revealed a subcapsular rupture along the greater curvature. A splenec-



FIG. 1. Anterior view of spleen showing site of rupture.

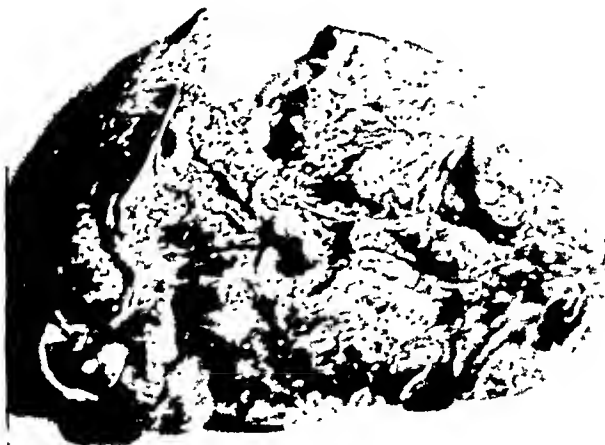


FIG. 2. Posterior view of spleen showing site of rupture.

to be slightly distended and with marked rigidity over both upper quadrants. He lay on his left side with his knees flexed on his abdomen, stating that this was the position in which he felt most comfortable. The erythrocyte count was 2,790,000; hemoglobin 48 per cent, and the leucocyte count 21,100 per cubic millimeter. The urine was normal. Blood pressure was 100/60; the pulse 140 and feeble, temperature 96°F., respiration 36. The abdominal pain was generalized. A diagnosis of ruptured viscus, probably the spleen, with severe hemorrhage was made and the patient prepared for surgery.

The abdomen was opened under spinal anesthesia and after incision of the peritoneum the abdominal cavity was found to contain a

tomy was performed and the abdomen was closed. The duration of the operation was twenty minutes.

Immediately following surgery the patient received 350 cc. of citrated blood intravenously and 10 per cent glucose by the continuous intravenous drip method. A total of 700 cc. of blood was administered by transfusion.

On the fifth postoperative day the patient developed a left lobar pneumonia. Polyvalent serum was administered and his condition immediately improved. Convalescence from then on was uneventful and the patient was discharged from the hospital on the fourteenth postoperative day. Following discharge from the hospital, blood findings were as follows: White blood count 12,000 per cubic mm.; red

blood count 3,350,000 per cubic mm.; hemoglobin 60 per cent; platelet count 350,200 per cubic mm.

McIndoe⁵ reports forty-six cases of late hemorrhage which occurred in patients between the ages of eight and sixty-three.

The pathological changes which occur in late hemorrhage may vary from a minor superficial capsular rupture with ecchymosis and slow hemorrhage; or there may be intrasplenic hematoma and subcapsular hemorrhage with subsequent capsular rupture; there may be a capsular and parenchymal rupture with an encapsulated perisplenic hematoma and the omentum tends to wall off this lesion.

The minor superficial ruptures are usually small fissures. The severity of the hemorrhage is not determined by the depth of the rupture but the importance of the vessels sectioned. For this reason fissures in the region of the hilum are more likely to produce severe hemorrhage and show the least tendency to localization. Many of these heal rapidly by simple scar formation. (Fig. 1.)

In cases in which there is an intrasplenic hematoma and subcapsular hemorrhage with subsequent capsular rupture there is usually a diffuse or localized subcapsular hemorrhage or more deeply placed hematonic formation. If, however, the capsule remained intact, the intrasplenic hemorrhage assumes large proportions, limited only by the tensile strength of the capsule.

Where there is a capsular and parenchymal rupture with formation of perisplenic hematoma, the lesions vary widely. The convex surface and posterior border are most frequently involved. In most cases of this type the omentum has been found to be blackened, swollen and infiltrated with old blood and plastered over the area of rupture.

The symptoms and signs of rupture of the spleen are those of hemorrhage, shock and diaphragmatic irritation. Abdominal pain is found in practically every case. It may vary from discomfort and dull aching to severe, stabbing paroxysms. It is usually

sharp, lancinating and localized in the left upper quadrant. Very frequently there is a radiation to the left shoulder. Dyspnea occurs and is probably due to diaphragmatic irritation, injury to chest wall or acute loss of blood. The most constant of the physical findings is abdominal rigidity and tenderness which is generalized at first, then localized to the epigastrium or left upper quadrant. There are varying degrees of tenderness over the splenic area, the left costovertebral angle and the base of the left side of the thorax. Shock is evident from the rapid, thready pulse, low blood pressure, low pulse pressure, the clammy skin, pallor, cold extremities and shallow respiration. The red blood count and hemoglobin values are usually lowered, especially can this be noted after repeated determinations.

Abdominal tap has been found to be of considerable aid in the diagnosis of subcutaneous injury of the abdominal viscera according to Wright and Prigot³ who report its use in fifteen cases of rupture of the spleen in which it gave positive results in thirteen. It is their opinion, however, that if abdominal tap gives negative results and the patient continues to show signs of concealed hemorrhage, the tap should be repeated.

In the differential diagnosis it must be remembered that contusion of the abdominal wall presents a similar picture of that of subcutaneous splenic rupture, except that in contusion the pulse rate, red blood counts and blood pressure are generally normal. Fracture of the lower ribs or left side with shock produces a similar picture. Very frequently fracture of these ribs is associated with rupture of the spleen.

Perforated peptic ulcer is the most commonly confused condition, probably because no history of trauma could be obtained from the patient. Cases have been reported in which this condition has been confused with acute appendicitis,⁶ ectopic pregnancy,⁷ cholecystitis,⁸ rupture of left kidney or liver, traumatic pleurisy and rupture of a gastric ulcer.⁹

In the preoperative treatment it is of greatest importance to institute means to combat the shock. Gum acacia should be given intravenously by the slow drip method while blood is being obtained for transfusion. When the blood is available it should be given by the slow, continuous drip method and continued during the operation. It is important that no patient suspected of having a ruptured spleen be given a preoperative enema because the clot formed in the spleen is very friable and may easily be dislodged by any muscular effort such as straining at stool.

The treatment is always surgical and splenectomy is the operation of choice but tampanade has been used. It is condemned because it is uncertain; the bleeding may not be controlled and even should it be successful the resulting abdominal wound is frequently weak. McIndoe⁵ advises against its use.

Rieweues, in 1892, performed the first recorded splenectomy for traumatic rupture. The operation may be performed through the wide transverse left subcostal incision of C. H. Mayo or through the upper left rectus incision of Bevan and Balfour. Injury to the pancreas must be carefully avoided as this may result in the formation of a pancreatic fistula or may cause digestion of the edges of the wound with eventual evisceration.

The removal of the spleen has not been found to produce any ill effects. The spleen is a part of the reticuloendothelial system and after its absence the remainder of the system assumes its functions. Also, accessory spleens are much more common than is believed. Curtis and White¹⁰ report accessory spleens in 10 per cent of cases in which autopsy is performed. They are more common in infancy and tend to disappear with age.

SUMMARY

1. A case is presented in which delayed hemorrhage from a ruptured spleen occurred seven days following original spleen injury.
2. During the latent period some healing takes place in the spleen.
3. The mortality is the same in delayed hemorrhage as it is for splenic rupture in general.

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REMOVAL OF A CEREBRAL MENINGIOMA IN A PATIENT WITH SEVERE CORONARY HEART DISEASE*

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A MAJOR operation in a patient with severe coronary heart disease is usually undertaken with great anxiety and considerable misgivings. Not only is one uncertain whether the cardiac reserve will withstand the added burden of an operation, but one is even more concerned with the probable precipitation of a coronary closure incidental or accidental to the operation.

However, it is interesting indeed and very encouraging to learn from Brumm and Willius,¹ that coronary heart disease should not be a deterrent factor in performing any major operation. In their study of 257 patients with severe heart disease, who were subjected to major operations at the Mayo Clinic there were only eleven deaths, or 4.3 per cent. It is also significant, that the average age of the entire group was 60.3 years. Only one of the 257 patients had a craniotomy, and that for a pituitary neoplasm.

From a somewhat different point of view Master, Dack and Jaffe² studied 625 seizures of occlusion of the coronary artery at Mt. Sinai Hospital. Thirty-five of this number (5.6 per cent) occurred following a major operation in the hospital.

Of the 295 intracranial meningiomas in Dr. Cushing's monograph³ there was not a single instance complicated by coronary heart disease. It seems, therefore, important to record the experience of a favorable outcome in a patient who had a benign cerebral neoplasm complicated by coronary heart disease.

CASE REPORT

L. B., a forty-two year old garage owner, was first admitted to Mt. Sinai Hospital on

November 25, 1938, because of right-sided convulsions. In his past history it is noteworthy that seven years previously he received a blow



FIG. 1. Downward displacement of left lateral ventricle without shift of third ventricle; absence of subarachnoid markings over left hemisphere.

to the left side of the head. There was no loss of consciousness and for a day he had headache. Three years before admission he fell on the ice, struck the left side of the head and lost consciousness for several minutes. Six months following the second injury he began to experience dull frontal headache, coming about once a week and lasting about one to two hours. For the next two years the headaches gradually increased in severity and frequency, but were easily controlled with aspirin. Six months before admission he noted numbness of the right side of the tongue, which was followed by twitching of the right side of the face. This lasted about three minutes and was not accompanied by loss of consciousness. One week later

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he had a similar seizure. The teeth were suspected as an offending focus, and all were very promptly extracted. Within the following two

The heart was enlarged to the left; blood pressure systolic 120, diastolic 90.

Electrocardiogram by Dr. A. M. Master

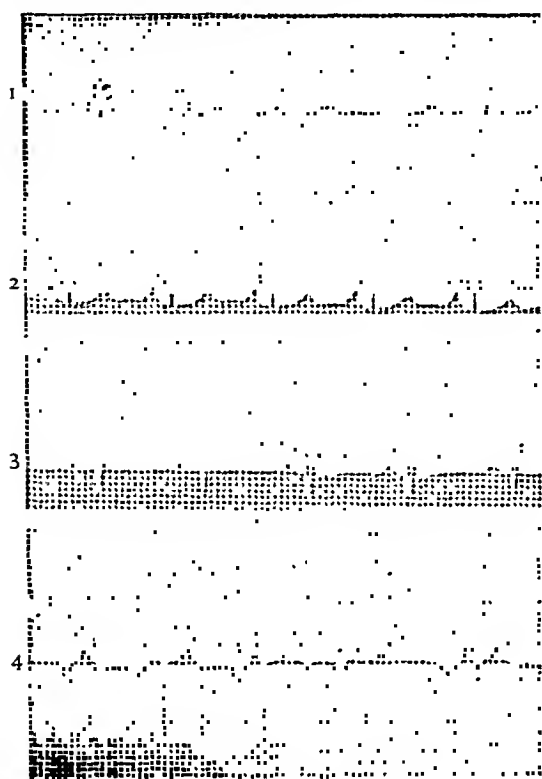


FIG. 2. Electrocardiographic tracings on second admission.

months he had six similar seizures. These had the added features of slight transient weakness of the right hand and numbness of the fingers.

Three weeks before admission he had two severe convulsions, one following the other. They were ushered in with numbness of the right side of the tongue, twitching of the right side of the face and right arm, each lasting about ten minutes. There was no loss of consciousness or sphincter control. However, he was unable to move the right arm until the next day. In between attacks he had no headaches.

For one and one-half years before admission he had been troubled with attacks of gripping precordial pain, radiating down the left arm. Moderate exertion caused dyspnea and often precipitated an attack of precordial pain. He coughed frequently and was unable to do any work.

The patient appeared plethoric, and there was evidence of mild bilateral exophthalmus.



FIG. 3. Meningioma with adherent dura.

showed regular sinus rhythm (70-75), unusual axis deviation, and deep QIII wave. Several days later the E.C.G. showed T₃ semi-inverted.

Abnormal neurological findings were indeed very few. The right corneal reflex was diminished; there was a suggestive right facial weakness, some drifting of the right arm and the deep reflexes were somewhat more active on the right.

Almost all concurred in the view that the patient had severe coronary heart disease and that it was questionable whether encephalograms should be done, for in any event it was doubtful whether surgery would be undertaken.

Nevertheless on December 20, 1938, encephalography was performed, which showed a downward displacement of the left lateral ventricle. The right lateral ventricle was somewhat larger than the left, but both were dilated. The third ventricle appeared in the midline and was of normal size and configuration. However, the subarachnoid markings over the left hemisphere were less distinct than those on the right. (Fig. 1.)

On December 23, 1938, the patient was discharged and advised to continue with luminal therapy.

Second Admission August 1, 1939. In spite of medications the convulsions continued as previously. The right-sided Jacksonian seizures with the sensory component recurred on the average of once every fortnight. For three months, however, there were additional symptoms of electric-like sensations spreading from

the right side of the face to the trunk and right hip. In addition there was numbness and paresis of the fingers on the same side. With the termination of a convulsion he noted extreme exhaustion, weakness of the right side of the body and temporary speech disturbance.

There was no demonstrable change in the neurological status. Roentgen films of the chest showed marked enlargement of the heart, particularly hypertrophy and dilatation of the left ventricle.

Electrocardiogram by Dr. A. M. Master showed left axis deviation, Q_{III} was deep, and Q R S was of low amplitude in lead II. (Fig. 2.)

The patient was about to be discharged for the second time, when he began to plead to be operated upon, stating that he would prefer to die of the operation than to have another convulsion.

The risks of the operation were again explained, also it was made clear that a two-stage procedure might be necessary, all of which he accepted unequivocally.

Operation. August 15, 1939. Under avertin and local novocaine anesthesia a frontoparietal craniotomy was performed. In reflecting the scalp and bone flap, there was moderate bleeding, but not sufficient to register any notable change in pulse or blood pressure. It was, therefore, decided to proceed further. As the dura was opened and reflected toward the longitudinal sinus, there came into view a well demarcated neoplasm about the size of a large plum, which was intimately attached to the under-surface of the dura. The vessels entering the neoplasm were clipped and severed and with gentle brushing the tumor was tilted out of its bed. (Fig. 3.) The dura overlying the tumor was completely excised. After careful hemostasis the dura was closed, and some Cargile membrane placed over the dural defect. The wound was then closed in layers.

At the close of the operation the blood pressure was 60 systolic and 40 diastolic. The patient was not moved from the operating

table. Within the next hour the pulse became imperceptible, the blood pressure could not be recorded, the patient became cyanotic and there was a cold perspiration over the entire body. A transfusion of 250 cc. of citrated blood was started promptly and within twenty minutes there were unmistakable signs of improvement. Nevertheless he was kept on the operating table for four hours longer, and then very cautiously transferred to bed and to his room.

From then on the postoperative course was unusually smooth. One week after operation he was out of bed.

On August 29, 1939, a fortnight after the operation he was discharged, symptom free and with no abnormal neurological signs. He is back at work, performing light duty, and still experiences precordial distress, which is not as disabling as before operation.

SUMMARY

A report is made of a patient, who had both severe coronary heart disease and a nonmalignant intracranial neoplasm. Operation at first was deferred, but with full realization of the risk involved, the operation was carried to a successful conclusion.

This single experience is also in keeping with the recorded experiences in the literature, that coronary heart disease should not be a deterrent factor in performing any major operation in which the indications are perfectly clear.

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New Instruments

PNEUMATIC AND ELECTRIC POWER UNITS MODIFIED FOR PRACTICAL USE IN NEUROSURGERY*

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WHILE the fundamental principles of neurosurgery have advanced rapidly, the development and refinement of instruments, especially for bone cutting purposes, have shown little progress since the advent of the specialty. The osteoplastic flap is, in general, elevated with the same instruments employed more than half a century ago, i.e., the hand brace with perforators and burrs, the Gigli saw and the DeVilbiss rongeur. This procedure with these instruments is, to say the least, not only a laborious task but exceptionally time-consuming.

Interestingly enough, mechanically powered tools have been developed in industrial fields of endeavor to a high degree of efficiency and with advantages far surpassing those of antiquated hand instruments; e.g., mechanically powered drills used for delicate work in the steel, stone and wood industries. Needless to say, the proper modification of time-tested mechanically powered tools to suit the conditions encountered in neurosurgery can be expected to be, and are, equally efficient in labor saving and time consumption. Thus, labor and time, both of which play a prominent part in surgical shock, are favorably influenced.

In the past, several have attempted to harness power units equipped for bone cutting purposes. Such units, however, have not become universally popular because of numerous disadvantages, viz.: (1)

sterilization difficulties; (2) uncontrollable power endangering the underlying nervous system, or even at times, the surgeon; (3) excessive vibration which in turn is transmitted to the patient's already compromised nervous system; (4) awkward handling features; and (5) excessive bulk and weight.

During the last seven years the writers have modified, tested and used various types of power units, both air turbines and electric motors. The air turbine is light (nine ounces) and handles with ease, gives adequate power, and delivers high speed (40,000 to 65,000 revolutions per minute) which is essential for bone cutting purposes. Heating of the bone does not occur if a small amount of normal saline solution is applied to the burr during the cutting process, and at such speeds tiny burrs actually appear to incise bone. The average osteoplastic flap can be cut in two or three minutes with ease. The writers have modified the air exhaust of the turbine diverting the air back through a separate tube in the handle, thus the field of operation can be protected from extreme air velocity. This modified turbine has been used successfully in clinical cases, and has many advantages over hand methods in a hospital where the nursing personnel is familiar with its use. Otherwise, sterility of the air cannot be certain and infection is always a possibility.

To deliver speed and power, a special air tank is required to make available neces-

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sary air pressure of from forty to one hundred twenty pounds, depending on the power and revolutions per minute desired.

lem of sterilization. Furthermore, pressure-reducing apparatus is available, which makes it possible to deliver promptly the

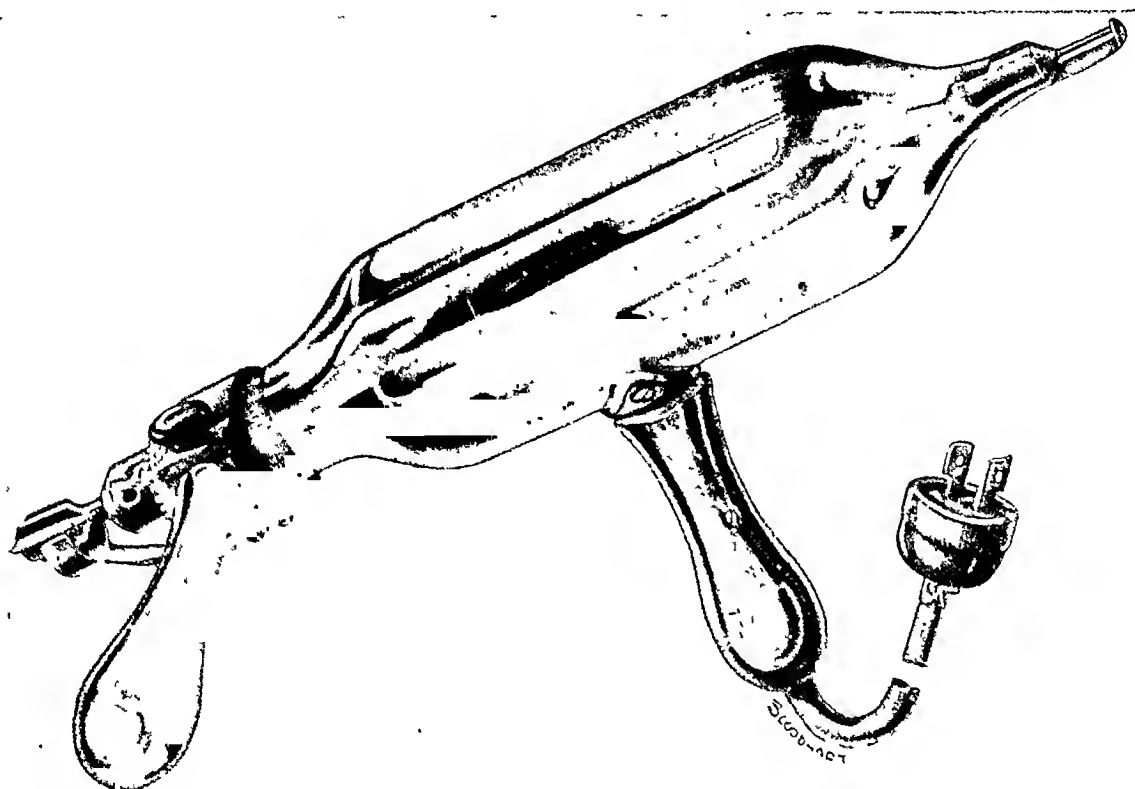


FIG. 1. The instrument with burrs attached as it appears when set up ready for use. It can be sterilized in an autoclave as any other instrument.

A small amount of air under such pressure will leak, even from the modified turbine. Thus it is possible that minute particles of matter may be driven from the pressure tank through the turbine into the field of operation. Since such particles of matter may be contaminated, they are always a possible source of infection unless the containers and air are sterilized and delivered with careful supervision to the turbine.

In the average hospital where the turbine is used only occasionally, sterile air is not conveniently provided. Moreover, the nursing personnel is often unfamiliar with the problem which naturally increases the hazard of infection. This in itself tends to violate the law of asepsis in surgery. With the proper facilities and experience, however, these disadvantages can be adequately overcome. Tanks containing air compressed up to as high as three thousand pounds are available and can be made sterile; this simplifies somewhat the prob-

desired air pressure. In general, however, the air turbine is not as simply practical as electric motors of sufficiently equal efficiency in the average hospital.

The electric motor is more practical especially when the surgeon is required to operate in a number of hospitals. Furthermore, it can give a greater range of power at lower speeds as well as high speeds. The efficiency of any power unit depends on its ability to deliver, (1) low speed with power for trephining, and (2) high speed for cutting. In turn the character of the cutting burrs must be such as to be compatible with the speed desired. The electric motor can be made to deliver the necessary power and revolutions per minute for all trephining and cutting purposes. Furthermore, it has simple handling features. (Fig. 1.)* It may be sterilized in an autoclave repeat-

* The motor of the instrument here described has been patterned after a motor designed by Doctor Vernon C. Luck for orthopedic purposes.

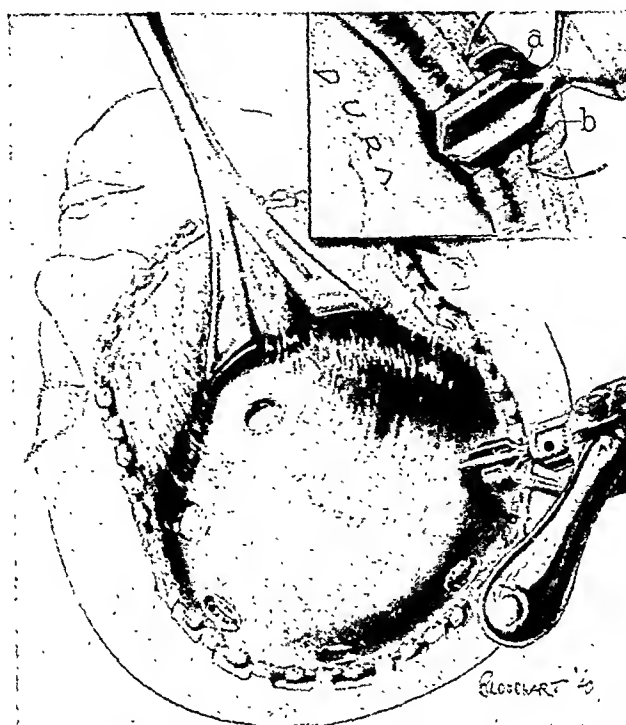


FIG. 2. Burr holes made in the skull require only a few seconds each. *a*, character of burr as patterned for safeguarding the dura; diameter of perforation one-half inch. *b*, adjustable depth gauge safeguarding the burr from going through the opening to an undesirable depth.



FIG. 3. *a*, side-cutting burr for cutting between perforations. The burr from which this was drawn makes an incision between perforations 2 mm. in diameter. *b*, dural protector.

edly as any other instrument, thus, asperities can be simply and rigidly maintained.

For making a rapid trephine opening in the skull up to one-half inch in diameter, 5,000 revolutions per minute is the ideal speed required. Higher speeds add very little, while slower speeds naturally lengthen the time. Such speeds, in turn, requires a special type of burr that will cut evenly and smoothly without jumping out of control. This burr can be best described by illustration. (Fig. 2.) Irrigation while drilling is not necessary; it does not facilitate cutting, and heating does not occur. This burr can be adapted to any available surgical power unit which will deliver the necessary revolutions per minute. At 5,000 revolutions per minute a perforation in even a thick skull can ordinarily be made in approximately six seconds.

The dura naturally requires protection with the use of high-speed drills, and providing this protection has best been accomplished by shaping the cutting point of the burr to an obtuse angle. Thus, when the bone perforation has been completed, the character of the point is such that the burr spins on the dura without doing any damage whatever. Actually, the point of the burr can be run at top speed on the skin of the palm of the hand without injurious effects; it merely spins on the surface. To prevent the burr from slipping through the perforation at high speed to an undesirable depth, a quickly adjustable depth gauge has been devised. The most desirable depth is one-eighth of an inch greater than the estimated thickness of the skull; thus, complete perforation is insured, and at the same time, the point of the burr does not extend far enough inward to cause damage. The depth gauge can be adapted to any available surgical motor unit and can be illustrated better than described. (Fig. 2, insert b.)

For making bone incisions between perforations, a modification of the side-cutting burr with a protective booth for the dura advocated by Frazier has been employed, utilizing, however, high speed (20,000 revolutions per minute). Above this speed, as

in the air turbine, very little cutting effect is gained, while below the cutting effect is proportionately lost. The cutting burr and dural protector are seen in Figure 3. Incisions in the skull as small as 1.5 mm. in width, can be made between perforations rapidly (ordinarily between eight and ten seconds each). This feature is extremely practical, especially when extending the bone incision from the lower perforations to the base of the flap. By the old method of using the usual DeVilbiss rongeur, the task is tedious, difficult and time-consuming; furthermore, considerable hemorrhage often occurs. Conversely then, with the utilization of the bone-cutting principle, these objectionable features can be precluded. Bone cutting in the average osteoplastic flap can be done with ease in two or three minutes' time. Heating of the bone does not occur when making the larger perforations. When cutting between perforations with the small cutting burr the addition of a few drops of saline solution continuously by the assistant will prevent heating. Thus, an osteoplastic flap can be elevated quickly, safely and with ease.

SUMMARY

1. The development of instruments, especially bone-cutting instruments, has been almost static since the laborious and time-consuming hand instruments first came into general use more than a half a century ago.

2. Mechanized tools in other fields have been developed to a high degree of efficiency, and when modified to suit the conditions encountered in neurosurgery, prove equally efficient in labor saving and time consumption; thus, surgical shock is affected favorably.

3. Mechanized instruments heretofore advocated have not been universally accepted because of numerous disadvantages and dangers.

4. Means for overcoming the disadvantages and dangers of mechanized bone-cutting instruments in neurosurgery are described for use with both electric and pneumatic power units.

A NEW APPARATUS FOR MECHANICAL CONTROL OF INTESTINAL FISTULAE*

A PRELIMINARY REPORT

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AN intestinal fistula which opens to the skin surface, whether it be from the large or small intestine, is always a

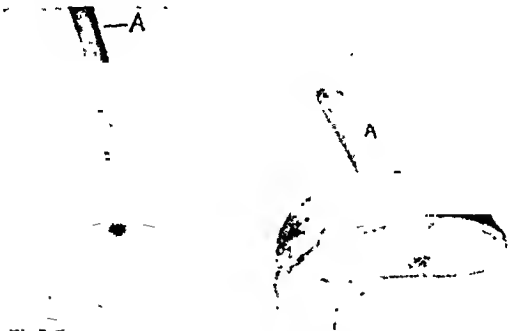


FIG. 1. Obturator before inflation. Note curved inferior surface. A, inflating tube.

distressing situation for both the surgeon and the patient.

Several problems are encountered in the management of fecal fistulae, which require the attention of the surgeon. First and most important is the maintenance of the general health and nutrition of the patient, which suffers materially due to loss of fluids through the fistulous opening. Usually this loss of body fluids is replaced by the intravenous or subcutaneous routes. Second, is the problem of the care of the tissues surrounding the fistulous opening. If suitable ointments or preparations, such as aluminum paste, kaolin, etc., are not used to protect the skin, marked excoriation usually results.

In most cases of fecal fistula there is extended hospitalization and disability. It is my purpose to present an apparatus of original design, which has been successfully used in a case of intestinal fistula to effect

the following: (1) To eliminate discharge from the opening and thereby permit retention of normal intestinal juices; (2) to prevent excoriation of the skin; and (3) to re-establish normal evacuation through the rectum. This device is to be used only in cases in which there is no mechanical obstruction distal to the fistula.

The apparatus as shown in the accompanying photograph consists of a soft rubber balloon with a tube A (Fig. 1) to permit inflation. The inferior surface is made of heavier rubber than the rounded superior surface, so that inflation causes the inferior surface to remain flat, while the superior surface bulges, thus preventing obstruction of the bowel.

The balloon is made in one piece; there are no cemented joints. In its deflated state the device is inserted into the lumen of the intestine, through the external opening, with the inflating tube A protruding. About 15 cc. of air are injected into the bag by means of a 20 cc. Luer syringe, and it can now be noted that the superior surface in its bulging, closes the external opening of the fistula and there is no further gross escape of intestinal contents.

By means of a suitable belt shown in Figure 2, the inflating tube, after being clamped to prevent escape of air, is tied under slight tension to the arched metal bridge. Replacement of air, without removal of the bag, is made about every four or five days. The following case demonstrates well the claims made for this device in this preliminary report.

* From the surgical service of Sydenham Hospital, New York City.

CASE REPORT

J. B., a forty year old colored male, was admitted to the ward service of Sydenham Hospi-

ment); Kahn 1; Kline 1; hemoglobin 72 per cent; red blood cells 4,020,000; calcium 10.4 mg. per cent.

The postoperative course was stormy. About

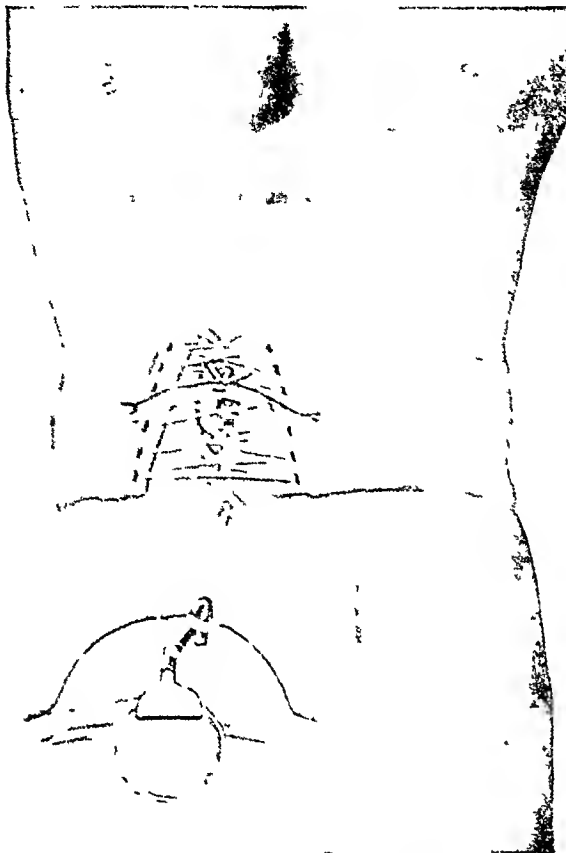


FIG. 2. Inflated obturator in situ attached to arched metal bridge on belt. Cross section of obturator in situ.

tal on April 8, 1940. At the time of admission he complained of pain in the right lower quadrant of his abdomen, of thirty-six hours' duration, which was associated with vomiting. There had been no bowel movement or flatus, except for slight return after two enemas.

His previous history was essentially negative, except for the fact that he had received a bullet wound of the abdomen twenty-two years before, at which time the lacerated intestine was repaired.

Physical examination on admission revealed a moderately distended abdomen with marked tenderness in the right lower quadrant. The patient was operated upon the day of admission for intestinal obstruction. The operation consisted of a division of adhesions and an appendectomy. During the process of separating the adhesions, the bowel was lacerated but immediately sutured.

Laboratory findings: Wassermann test negative (patient was receiving antiluetic treat-

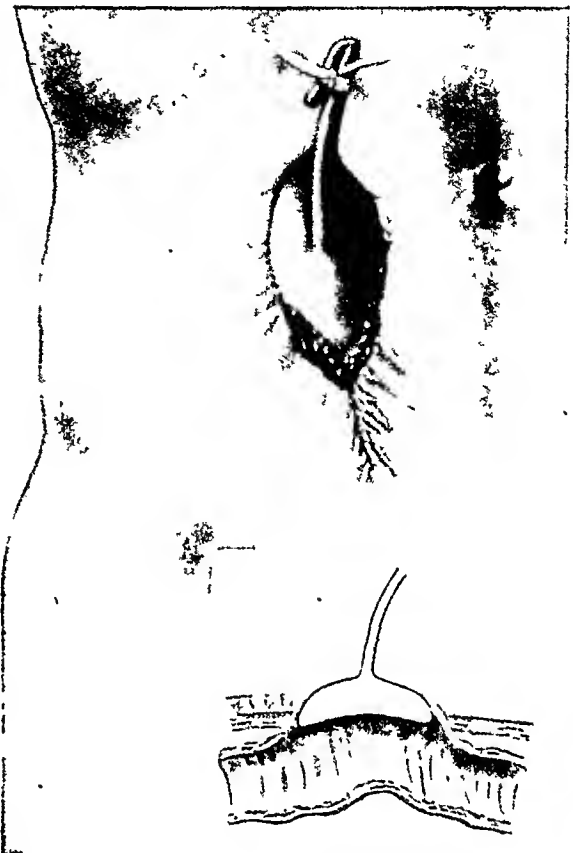


FIG. 3. Inflated obturator in situ without belt. Note closure of fistulous opening. Longitudinal section of obturator in situ.

ten days postoperatively, the patient developed an intestinal fistula which discharged fluid and formed feces. During his stay in the hospital, he received several blood transfusions, as well as glucose and saline infusions. The tissues surrounding the fistula showed marked excoriation.

The patient was confined to bed until September. During this time he suffered considerable loss in weight and became dehydrated. The fistula continued to discharge constantly, its size diminishing slightly. The skin healed, and subsequently became excoriated, in spite of various local treatments. Several forms of obturators were employed to seal the fistula with only temporary success. During this entire period, from April until September, the patient had no spontaneous bowel movement or flatus.

On September 9, 1940, our new appliance was inserted into the fistula. On September 12, i.e., three days following insertion, the patient had his first normal spontaneous bowel movement since the operation. The original balloon was

allowed to remain in situ for about four days, at which time it was removed because of defective construction. Another balloon was made and was inserted on October 18, 1940. The following day the patient had two normal bowel movements, though no bowel movement occurred while the balloon was not in situ. The patient was discharged from the hospital on October 20, 1940, with the apparatus in place. His weight was 119½ pounds.

Follow-up observations have been made at frequent intervals during the eleven weeks since his discharge from the hospital. He has had normal bowel movements daily and has gained twenty-seven pounds. He goes about his daily work without inconvenience. His skin is not excoriated, and the lower angle of the wound shows fresh, healthy granulation tissue. His strength has improved remarkably and he has a sense of well-being.

On January 8, 1941, the patient was readmitted to the Sydenham Hospital for closure of the intestinal fistula. Two days after admission, the patient was operated upon under a general anesthetic by Dr. Joseph B. Stenbuck. The intestine was dissected free from its attachment to the skin and subcutaneous tissues, and the opening in the bowel was sutured in three layers. The skin and subcutaneous tissues were sutured. Drains were placed in the upper and lower angles of the wound.

Prior to the use of the apparatus, the lumen of the intestine distal to the fistula barely admitted one finger, due to concentric constriction. At the time of operation, however, the constriction had entirely disappeared and there was present a normal intestinal lumen. Apparently the apparatus over a period of four months had acted as a dilator—an additional extremely useful function.

Following operation the skin edges separated in part, but healing of the subcutaneous tissues and of the intestine took place. The patient had a normal spontaneous bowel movement on the fourth postoperative day. He was discharged from the hospital on January 31, 1941, with a granulating skin wound.

The apparatus used on this patient may be used in any case of intestinal fistula, in order to allow the opening to become smaller prior to operative closure. It is possible that by means of this apparatus, operation may not be necessary, due to spontaneous closure over the apparatus. In any case, the patient's nutrition may be supported because the intestinal juices and food are not lost. This obviates the necessity also of using parenteral fluids and transfusions.

SUMMARY

We have described a device which has successfully controlled the discharge from an intestinal fistula, with the following good results: (1) Re-establishment of normal bowel movements; (2) retention of body fluids; (3) elimination of excoriation of tissues surrounding the fistula; (4) dilatation of constricted intestinal lumen; (5) gain in weight; and (6) decrease in period of disability.

Appreciation is due Dr. Joseph B. Stenbuck for his many helpful suggestions and for his encouragement in this work, and also to Mr. L. T. Hilborn, president of the Clay Adams Company, for his generous co-operation.



A NEW PROCTOSCOPE

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THE usefulness of a proctoscope will be enhanced if its field of visibility is augmented and made accessible for

constructed that is more adaptable than the customary straight tubular type. The same principles which have provided greater

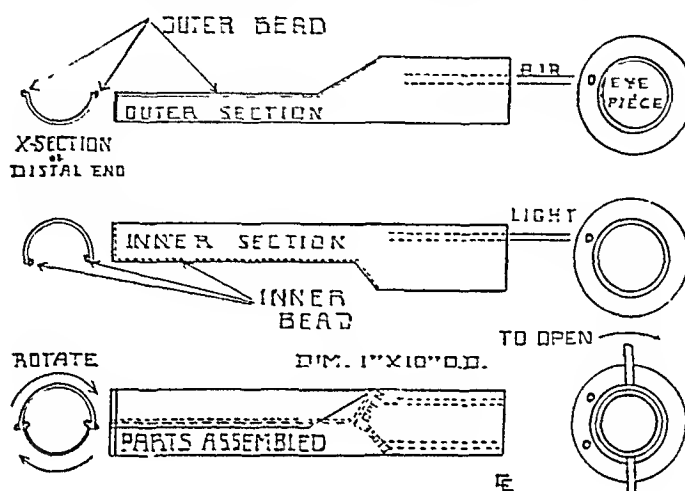


FIG. 1. Plan showing parts of proctoscope.

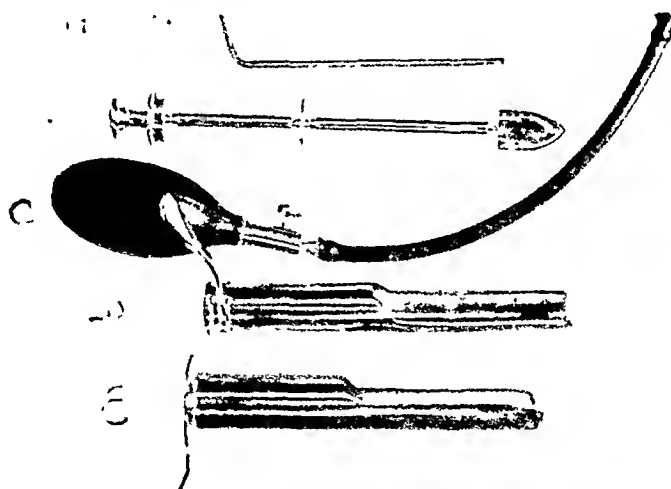


FIG. 2. Shows parts and accessories of proctoscope: A, light; B, obturator; C, inflator; D, inner shaft; E, outer shaft.

instrumentation. For example, the procedure of fulguration may be facilitated if these advantages are obtained.

Proctoscopes now in use have the common disadvantage of providing only the limited field of exposure which is observed through the distal circular opening of the instrument. Such limitation of exposure imposes a restriction of proctoscopic possibilities. To provide a greater accessible field of visibility a proctoscope has been con-

exposure for the anoscope have been applied to the proctoscope.¹

By this adaptation a longitudinal area of the bowel wall may be exposed to a distance corresponding to the length of the instrument. Such an exposed area is much larger and more accessible than that obtained by the ordinary proctoscope.

When two partial hemicylinders of tempered steel are adjusted so that the inner cylinder is smoothly encompassed by the

outer one, a variable degree of lateral exposure is obtained by rotation of the instrumental parts. When these semicylindrical shafts are assembled so that a hollow tube

mentation. Inspection of the mucosa is facilitated by a movable light carrier, an air inflator and a magnifying lens for the eye piece.

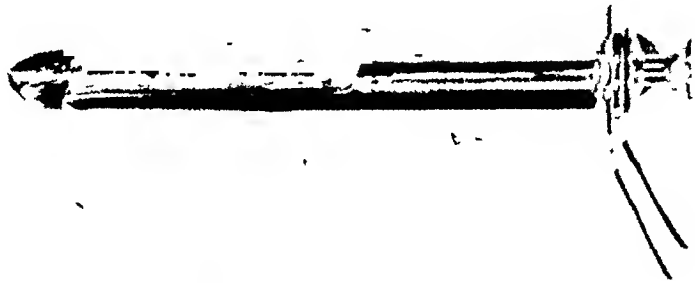


FIG. 3. Shows proctoscope closed with obturator inserted.

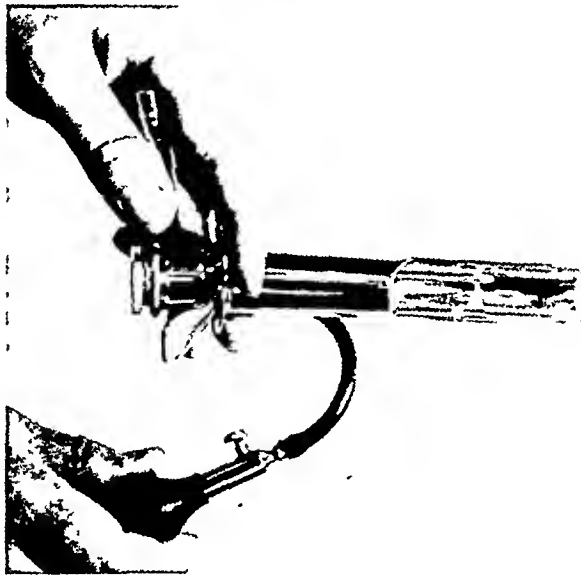


FIG. 4. Shows proctoscope opened with light and inflator attached.

is formed, the instrument may be inserted, with an obturator, as an ordinary proctoscope. Once inserted, rotation of the inner shaft will provide exposure of the lateral bowel wall for an extent of 180 degrees. Rounded metal strips of beading on the edges and angles of the hemicylinders prevent injury to the bowel during instru-

SUMMARY

A new proctoscope is described which provides wide exposure.

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AN INTRA-ABDOMINAL RUBBER RETRACTOR

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IT has long been recognized that gauze employed in the abdomen often is traumatic, readily evidenced by the me-

various sizes or rubber envelopes into which gauze or stays can be inserted to produce the desired rigidity. They are



FIG. 1. Two sizes of the laparotomy pad with tape and steel ring attached.



FIG. 2. Method of introduction of pad into the abdomen.

chanical peritonitis occurring when gauze has been used during a long laparotomy. Moreover, it is unwieldy and frequently must be used in large quantities to accomplish its purpose. Rubber, on the other hand, is nontraumatic, may be used for long periods of time, withstands sterilization well, but is nonabsorbent.

Most of the rubber devices in use are either in the form of thin rubber sheets of

bulky and present few features making them superior to gauze.

We describe a new laparotomy pad which may be used wherever gauze is used in the abdomen, and it also presents the features of an intra-abdominal retractor. It is constructed of a square latex rubber sheet into the edges of which has been sealed a fine steel spring coil. It is marketed in two standard sizes four and three-fourths

inches by four and three-fourths inches and eight inches by eight inches, but may be made in any form. The larger sizes contain

tion is desired. The large pad is useful principally in pelvic work, while the smaller one may be used throughout the abdomen.



FIG. 3. The pad unfolds in this manner when in place in the abdomen.

additional coils in the center for increased strength. At one corner of each pad an eyelet is placed through which a cloth tape may be threaded if desired. It is possible to fold or roll these pads into any desired shape, and upon release they will assume their normal character. They possess sufficient rigidity to dam back the intestines, but are not capable of traumatizing the viscera. They may be repeatedly sterilized by boiling, do not lose their form even after long usage, can be patched if torn and are easily introduced and removed from the abdomen.

In use, the pad rolled into the form of a tube or folded upon itself is introduced through the abdominal incision, and with the viscera displaced, springs open thus damming the intestines from the desired operative field. A flat ribbon retractor may be placed against the pad if further retrac-

The small pad is especially applicable to gallbladder surgery.

Another feature of this pad is its utilization as a retractor of omentum and intestines during closure. It is placed beneath the peritoneum with the tape protruding from one angle of the wound. Thus the peritoneum may be closed without fear of involving the viscera in the suture to within two to three inches of one angle, when the pad may be removed.

A contraindication to the use of this device is adhesions. These must be separated before introduction of the pad.

This pad has been designed to make available a rubber device to replace gauze in the abdomen wherever possible, and offer the added feature of an intra-abdominal retractor. It is in use at the Long Island College, Greenpoint and Methodist Hospitals in Brooklyn, New York.



Bookshelf Browsing

THE HISTORY OF HEMORRHOIDS*

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BECAUSE of their prosaic and widespread incidence throughout the ages, hemorrhoids have played a highly important rôle in the history of medicine, as well as in the development of civilization.

The loss of blood has always been an intriguing phenomenon, attracting the attention of medical men ever since the beginning of the history of medicine. The word, "hemorrhoids," is derived from the Greek, and means "the flow of blood."¹ Hippocrates applied this name to the flow of blood from the veins of the anus, but subsequent writers used the term synonymously with hemorrhage. Thus, Aristotle described hemorrhoids of the mouth, and Cornelius Celsus, Aetius of Amida, Paul of Aegina and later surgeons of the Byzantine period described hemorrhoids of the various organs such as the uterus and bladder.

ETIOLOGY AND PATHOGENESIS

Before Hippocrates' time, (5th Century B.C.) any disease in or around the anus was called hemorrhoids. Hippocrates considered hemorrhoids a favorable disease, and often even a useful one. He attributed the phenomenon of "flowing" to a general purification of the organism.² This hemorrhoidal flow, formed, "by the reunion of all the wastes of the organism, is made up mainly of blood of the spleen and of the bile, which is drawn out, that is to say out of the spleen, and escapes through the hemorrhoids as from the rectum.

"The disease of hemorrhoids," he wrote, "is formed in this way: if bile or phlegm be determined to the veins in the rectum, it heats the blood in the veins; and these veins becoming heated, attract blood from the nearest veins, and being gorged, the inside of the gut swells outwardly, and the heads of the veins are raised up, and being at the same time bruised by the faeces passing out, and injured by the blood collected in them, they squirt out blood, most frequently along with the faeces, but sometimes without faeces."

Hippocrates also believed that hemorrhoids prevented other diseases. "Those who have hemorrhoids," he writes, "are not subject to pleurisy nor to pimples, nor to boils, nor perhaps to leprosy. It is a fact that of those who have been completely cured (of hemorrhoids), several have been quickly afflicted with one of these diseases fatally." This principle is discussed under the title, "Metastasis," in Hippocrates' writings. In other places he draws attention to the relationship existing between hemorrhoids and diseases of the liver, and he mentions that ascites is a consequence of hemorrhoids.

Galen (2nd Century A.D.) sets forth a similar conception in the fourth book of the "Epidemics,"³ and Celsus (about 25 B.C. to about 40 A.D.) held a similar point of view.

These ideas held until the seventeenth century, when Morgagni⁴ observed that

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hemorrhoids did not exist in animals, and therefore attributed them to the erect position of man and to a hereditary predisposition.

Georg Ernst Stahl (1660–1734), a German physician and chemist of the seventeenth century, did much to influence the ideas of the causation of hemorrhoids.⁵ He was a professor of medicine at Halle and physician to the King of Prussia, and his high position commanded respect for his theories. According to Stahl and his school, hemorrhoids become venous reservoirs, destined to collect, in order to reject them later, all the wastes of the body. In other words, the flow of blood from hemorrhoids was considered a "vital act" due to a plethora and not a disease, per se, i.e., the equivalent of menstrual flow.

The difference between Stahl's theories and those of the ancients is that he did not believe as Hippocrates did, that the blood given off by hemorrhoids was splenic in origin; Stahl believed that the blood flowed into the hemorrhoidal veins because of an overflow. If the flow were stopped, all chronic diseases and particularly mental disorders would follow.

Many subsequent writers attributed hemorrhoids to defective circulation in the anorectal region, thus opposing Stahl's plethora theory with one of mechanical stoppage.¹ This theory is first mentioned in the Dictionary of James (1760), attracting attention to the difficulty which the blood encounters in circulating from the hemorrhoidal veins to the portal vein and the liver because "the veins are vertical and possess no valves." These circulatory troubles are due "to the presence of acrid and caustic matters which frequently cause spasms, making the circulation of blood irregular." This conception has persisted to the present day. Some modern authors attribute pruritis ani and peri-anal rash to the action of toxins which are stagnant products in the hemorrhoidal veins.

In the eighteenth century, constitutional diatheses and temperaments attracted the attention of the physicians, and therefore

took their place in the description of this affliction. Montegne illustrated this trend with his famous portrait of a man with hemorrhoids: "The man with hemorrhoids is large, thin rather than fat, yellow of coloring has large veins winding up the arms and on the hands, legs and feet. He has black hair, a dark fire animates his look; he is brusque, high strung, his passions are violent, his resolutions firm; he is a heavy eater, but is indifferent to the choice of food. He is often tormented by gas, and almost always constipated."

Quenu, in the nineteenth century, introduced the idea of inflammation into the pathogenesis of hemorrhoids.

Summing up the theories of the causation of hemorrhoids, as they evolved through the ages, we find the following periods:

1. *The pre-Hippocratic period* in which all infections of the anal region are called hemorrhoids; this confusion which is carried by some writers to the middle ages, makes interpretations of the descriptions of ancient writings very difficult.

2. *The period of Hippocrates and his school*, which localizes hemorrhoids to the rectal veins, but attributes to them the rôle of beneficial expulsion of blood.

3. *The period of Stahl and his coherents* who consider hemorrhoids as an indication of a surplus of blood. The hemorrhoidal veins are intended to receive and eliminate waste products, thereby having a function analogous to that of menstrual flow.

4. *The post-Stahlian period*, during which the theories of constitutional, nervous, mechanical, and infectious causes are formulated and developed; many of these theories are still in use today.

HISTORY OF THE TREATMENT OF HEMORRHOIDS

The diversity of conceptions of the nature of hemorrhoids naturally influenced the modes of treatment. We, therefore, find a wide divergence in treatments, commensurate with the prevalent ideas of hemorrhoids at a given time in history. The

ancients disagreed radically as to whether hemorrhoidal flow should be stopped, diminished or augmented.

may be left behind. And burn so as to leave none of the hemorrhoids unburnt, for you should burn them all up."

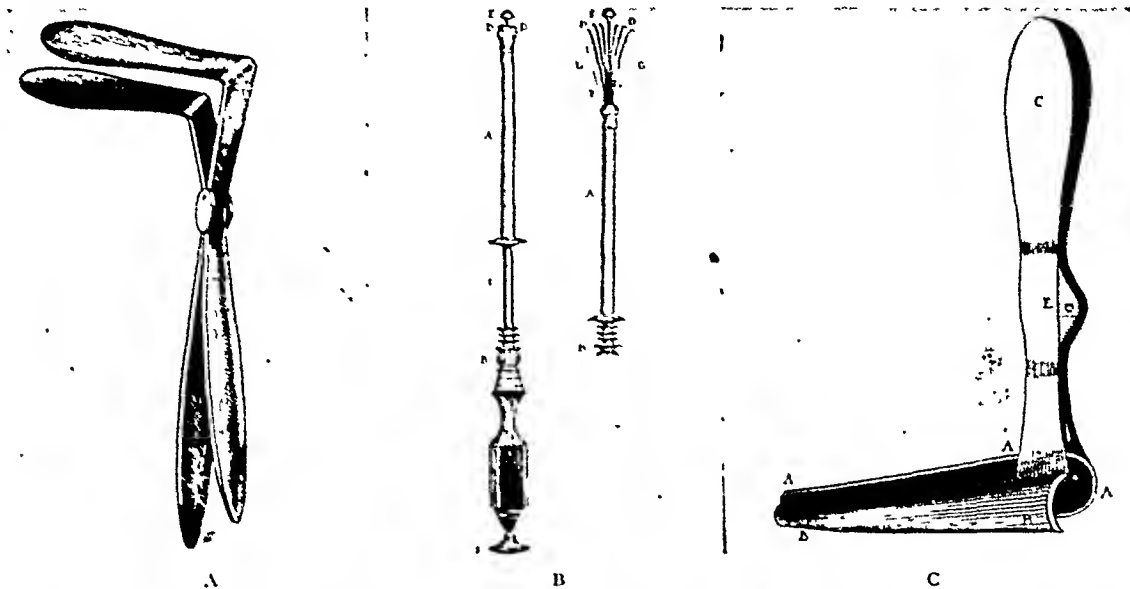


FIG. 1. A, anal speculum in bronze, found in the ruins of Pompeii. B, diverging crochet hooks of Chaussaignac, used to bring forth hemorrhoids by inserting the instrument closed, and withdrawing it with the hooks diverging. C, anal speculum illustrated in the Dictionary of James (1760). (Bensaude, R. *Presse méd.*, 45: 1301, 1937.)

In this regard, Hippocrates contradicts himself. In one passage of his writings, he advises against the suppression of hemorrhoids while in others he recommends the destruction of all the clusters. The following passage has been translated from Hippocrates writings by Adams:²

The disease of hemorrhoids "is to be cured thus: In the first place it should be known in what sort of a place they are formed. For cutting, excising, sewing, binding, applying putrefacient means to the anus,—all these appear to be very formidable things, and yet, after all, they are not attended with mischief. I recommend seven or eight small pieces of iron to be prepared, a fathom in size, in thickness like a thick specillum, and bent at the extremity, and a broad piece should be on the extremity, like a small obolus. Having on the preceding day first purged the man with medicine, on the day of the operation apply the cautery. Having laid him on his back, and placed a pillow below the breech, force out the anus as much as possible with the fingers and make the irons red-hot, and burn the pile until it be dried up, and so as that no part

(This is contrary to previous advice given at Aph. vi, 12, in which he advised leaving one hemorrhoid, as a safety valve, so to speak, to the system. Celsus and Paulus Aegina followed this rule in their ligation operations, not mentioning cautery. Aetius, however, followed the principle of removing all the clusters.)

Hippocrates recommended a paste made with urine to be applied for hemostasis after operation.

The treatment of hemorrhoids by cautery has been a controversial issue since ancient times. Although it was recommended by Hippocrates and Albucasis, it is not described by Celsus or Paulus and is condemned by Audreas and Cruce. Dupuytren and Paré did not agree with the principle of cautery. Sir Charles Bell, the famous eighteenth century English surgeon said, "smoke rising from the anus under the influence of a hot iron should impress the friends of the patient and bring back their minds to the days of the Inquisition." To this day surgeons are divided in their approval of cautery in the treatment of hemorrhoids.

Galen employed bleeding from the arm to stop the flow from hemorrhoids and bleeding from the feet to bring it back.

The old books are filled with medical prescriptions, some of the most interesting of which are those of John Arderne⁶ (1412):



FIG. 2. A, operation for hemorrhoids done by Aetius. The surgeon has pulled down the hemorrhoids with a hook and has cut them in a circular manner with a large blade. B, from the same period, showing the surgeon exerting finger compression to the anus after excising the hemorrhoids. Notice the spurt of blood falling into the cup. (Bensaude, R. *Presse méd.*, 45: 1391, 1937.)

Suction cups were applied to incisions on the thighs to prevent hemorrhoidal flow by Galen, Oribasius and Antyllus. They also recommended careful irrigation of the place of application with hot water at the same time.

Another method which Galen used to stop the flow of hemorrhoids was to apply tourniquets around the hands and arms, while he warned that tourniquets around the thighs would have a different effect and should not be employed except in hemorrhages of the upper portions of the body.

Celsus recommended that in some cases the flow of blood from hemorrhoids should not be suppressed for fear that the inspissated, infected blood would be carried to the heart and viscera.

Ambroise Paré (1545) made the following recommendations: "If they (the hemorrhoids) flow moderately and the patient withstands elimination without discomfort they must not be stopped at all because it will aid him in avoiding mental depression, mania, leprosy, congestion of the bladder and other affectations such as pleurisy and malignant ulcers, but if the flow of blood is diminished one should stop it for otherwise it causes hydrops by the cooling of the liver with the resultant weakening of the entire body."

"Against bleeding piles: moisten the finest wheat flour with the juice of millfoil and make it into pills. Give three or four daily. And the phlebotomy should be performed from the basilic vein of the arm on account of the previous materis morbi, and afterwards from the saphenous vein at the outer ankle. The tibial saphenous diverts the hemorrhoid flux and permanently restrains the piles.

"Against inflamed piles: Wash the part in the juice of parsley and salt. . . . Powdered hare burnt stops the bleeding from piles better than anything."

The great number of remedies in vogue inspired Ravaton, in 1776, to write: "Everyone uses special remedies for hemorrhoids, because those that have been recommended by the great masters of the Art have worked out very poorly."

The Dictionary of James (1760) suggests a conservative method of therapy, consisting of a moderate and exacting régime: "One should avoid carefully the remedies that are warm, and restrain the use of myrrh, saraphen and all elements of the same quality; avoid wine, debauchery, bad temper, violent exercises, immoderate use of women, and do not ride horseback."

The truly surgical period in the treatment of hemorrhoids starts in the nine-

teenth century with the work of Kerby (1818), Brodie (1835), Smith (1835), and Salmon (1835) in England and America, used at that time. Among them are metal rings for dilating the anus, and an instrument for delivering hemorrhoids, consisting



FIG. 3. German woodcut of the fifteenth century showing a country innkeeper retracting one buttock with his hand, showing his affliction to the surgeon. The peripatetic surgeon treats his patient while his horse waits. The man of the art with glasses and lantern holds the pincher with which he will crush or cauterize the hemorrhoids.

and of Boyer (1830), Chassaignac (1858), and Benoit in France. Yet the surgical processes used are essentially those that have been known since earliest antiquity.

Excision alone was practiced by Hippocrates, Galen, Celsus, Aetius, Albucasis, Rhazes and others.

The ligature operation was done by Galen, who recommended the use of a strong flax thread made to traverse the base of the tumor by means of a needle. The ligature was then tied on each side and the tumor permitted to slough off.⁷ In 1813, this procedure was quite popular with French surgeons; but later, owing to some accidents, it lost its popularity. However, Miles and others do essentially the same procedure today. Amputation of the tumor after ligation of its base was popularized by Salmon, and is the procedure of choice at the St. Mark's Hospital, London, to the present day.

Instruments used in operations for hemorrhoids have been as strange as they have been numerous. In Scultetus' *Armamentarium Chirurgicum*⁸ (1656) are descriptive illustrations of some of the instruments

of chains with hooks on one end, and attached into a handle at the opposite end for traction. Another method was to put a stout cord through the base of the hemorrhoid by means of a heavy needle. Using this for traction, the hemorrhoids were burnt off with cautery. One of the most interesting methods of curing hemorrhoids was the lineal crushing of hemorrhoidal clusters as practiced by Chassaignac. This surgeon began by bringing out the hemorrhoidal clusters with an instrument consisting of diverging and multiple branches, sort of an upside down umbrella, which is introduced into the rectum closed, and which is pulled out after it has been opened, thus bringing forth the hemorrhoids. (Fig. 1B.)

The exact origin of the injection treatment of hemorrhoids is not known although it is said that one Mitchell of Clinton, Illinois, originated this form of treatment in 1870. However, it is generally known that it was first practiced by charlatans, known as "healers of hemorrhoids," both in England and the United States. Although this method at

first was looked upon with disdain by the physicians of the medical art, it finally attracted the attention of some of them and a few English surgeons began to practice it about 1871. It was not commonly accepted until Dudley Wright published his treatise on the subject near the turn of the twentieth century.

ECCLESIASTICAL WRITINGS AND FOLKLORE

It is said that there were doctors who specialized in the treatment of hemorrhoids in Egypt before Joseph was sold as a slave. The word, "hemorrhoid," was mentioned in many passages of ancient Hebrew literature.⁹ In the bible, the term, "emerod," was used. In Deuteronomy, the Fifth Book of Moses of the Old Testament, one finds the following phrase: (Chap. xxvii, paragraph 27) "And the Lord will smite thee with the botch of Egypt and with the emerods and with the itch whereof thou canst not be healed."

Three centuries later the Philistines, who captured the sacred ark were stricken with hemorrhoids, according to the first Book of Samuel. The Philistines called the priest and divine men and asked them what to offer with the Ark of Jahweh. (Samuel I, Chap. vi, paragraph 4). "Then said they, what shall be the offering which we shall return to him? (The God of Israel). They answered, 'Five golden emerods, and five golden mice, according to the number of the lords of the Philistines: for one plague was on you all, and on your lords.'"

There has been much controversy over the translation of these passages. Church¹⁰ is convinced that the term emerod implies a venereal disease. Neustatter¹¹ on the other hand, offers a logical argument indicating that the scourge was not syphilitic, but does not state that the word actually means hemorrhoids. He cites several writers who interpreted emerods as implying syphilis, including Trapp (1662) who said it was "lues venerca," Hensler (1783), Fridrech (1848), and Haeser, who called emerods "condylomata at anum."

J. F. Von Meyer in his amendment of Luther's version, renders it as "feigwarzen," as does the Berlenburger Bibel. Jutting's Biblisches Worterbuch defines feigwarzen as (syphilitic) ulcers or boils, like figs, or hemorrhoidal tumors.

Galen wrote that the "Stone of India worn around the neck will stop the hemorrhoidal flow." For the same purpose, placing an emerald in the navel had been advocated. Another method was carrying between the shoulders the roots of a Century plant. Men chose black, women, white ones.

In the middle ages it is interesting to note that the term, "hemorrhoids," is almost completely lost. This is perhaps due to the fact that it was one of the words which the decency of language forbade. During this era the affliction was called "the illness of St. Fiacre," thus becoming a respectable illness.

In France, chestnuts were considered a good remedy. It seems as though the French attributed good results to chestnuts because of their resemblance to hemorrhoids. It is interesting to follow the influence of chestnuts in the treatment of hemorrhoids into the nineteenth century, when Artault recommended the tincture of chestnuts as an internal treatment.

It had also been recommended that the back leg of a toad or an entire dried toad, be worn around the neck or under the arm pits as a preventive measure against hemorrhage from the veins. Among other methods of treatment we find various erotic practices involving the use of animals. These processes were still in use in France as late as the middle of the nineteenth century.

In many artistic works, as well as in the letters of famous men of history, numerous allusions are made to hemorrhoids. For example, few of us realize when we listen to Goethe's "Faust," that the editor, Nicolai, is referred to as a "Proctophasmism." One of Mephistopholes' lines, during the Walpurgis night reads: "He now will scat him in the nearest puddle; The solace

this, whereof he's most assured: And when upon his rump the leeches hang and fuddle, He'll be of spirits and of Spirit cured."

Don Juan, of Austria, who won the battle of Lepante (1571), died at Namur, of a hemorrhage four hours after an incision made for a large cluster of hemorrhoids.

Martin Luther, the great reformer, suffered from prolapsed hemorrhoids, and described his illness at great length in a letter to Justin Jones written in 1528.

According to Heinrich Heine, the poet, Meyerbeer was stricken with hemorrhoids, and Heine is even said to have written poetry about the "hemorrhoidal music" of the great composer.

SUMMARY

The methods of treating hemorrhoids have been remarkably similar in principle throughout the history of medicine. The surgical procedures employed by Hippocrates included the ligature operation, excision and cautery. These procedures have been carried through the ages with only minor alterations or variations but are the basis for all operations for hemorrhoids in use today.

The fact that hemorrhoids are frequently mentioned in historical writings emphasizes

the influence this affliction has had upon man throughout the ages.

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Selected Book Reviews

VACATION READING

AT this time of the year the average physician becomes a bit stale mentally. He has little or no taste for textbooks or weighty tomes; his thoughts wander to other things. But whether on vacation or doing merely routine work he, by force of habit, picks up a book at the close of the day and reads. Some prefer a detective story, others a novel and still others a book on the war. We are offering a few books by physicians which we found interesting. Each in its own way is far above the average and each gave us no end of pleasure. Thus, we recommend these books without reservation.

MAGIC IN A BOTTLE*

BY MILTON SILVERMAN, PH.D.

MAGIC in a Bottle, by Milton Silverman, gave us more pleasure than one would think possible from the title. The various members of our family also found it a "swell book." It contains the true stories of ten wonder-working drugs and of the men who, wittingly or unwittingly, discovered them. We learn the full story of Sertuerner and morphine, Pelletier and quinine, Withering and digitalis, Koller and cocaine, Lister to Ehrlich to 205, Kolbe and aspirin, Fischer, von Mering and the barbitals, Eijkman and the vitamins, Brown-Sequard and the hormones, and Domagk and sulfanilamide. This may not sound exciting, but we assure you that the stepping stones to the final chapter concerning these drugs—the chief drugs in modern practice—and the human beings behind them make both fascinating and interesting reading. Physicians, as a whole, know very little about medical discoveries and the events leading up to them. Therefore, while this book will entertain, it will also prove a fountain of facts. Our hope is that thousands of

* New York, 1941. The Macmillan Company.

physicians will get this book, for we are certain they will enjoy it as much as we did.

THE DOCTOR TAKES A HOLIDAY . . . AN AUTOBIOGRAPHICAL FRAGMENT*

By MARY MCKIBBIN-HARPER, M.D.

THE Doctor Takes a Holiday is worthy of a high mark. Dr. McKibbin-Harper has published several charming sketches of her travels in the Far East: *The Doctor Looks at Turkey*, *Greece*, *Scandinavia*, etc. Her readers will welcome this new volume.

In order to give a short résumé of what the book is about we quote from the Foreword: "The book, essentially one of travel in the Orient, is sociological in its scope, describing native customs, religions and superstitions and it is an eye-opener as to native medical customs and the beneficent influences of education and modern health service. It tells of men and women doctors and other interesting people met in a round-the-world tour while amusing experiences are cleverly illustrated by many pen drawings of Kathryn Yager Lewis." *The Doctor Takes a Holiday* is an interesting, readable and authentic travel book of a new kind.

TEST TUBES AND DRAGON SCALES†

By GEORGE C. BASIL, M.D.

In Collaboration with Elizabeth Foreman Lewis

APATIENT gave us *Test Tubes and Dragon Scales*, by George C. Basil, M.D., formerly superintendent of the "Syracuse-in-China" Hospital, Chungking, and we threw it aside, inwardly wondering why people make presents of books to one who gets more books for review than he can read. One cold, snowy night we chanced to pick it up. Casually, we began reading it, and read it from cover to cover in two installments. We learned all about an American physician in China and his trials, tribulations and adventures. The book is different, superbly written, provides full enjoyment and at the end leaves one satisfied. Your wife, daughter and sister will also enjoy it.

* Grand Rapids, Iowa, 1941. The Torch Press.

† Philadelphia, 1940. The John C. Winston Company.

A DOCTOR'S HOLIDAY IN IRAN*

BY ROSALIE SLAUGHTER MORTON, M.D.

A DOCTOR'S Holiday in Iran, by Rosalie Slaughter Morton, the author of "A Woman Surgeon," is particularly timely and interesting in view of the present world conflict. Although one can take it as easy, light reading, it is, after all, a valuable contribution to the bibliography of Iran. "The home of the Peacock Throne has always been, at least to the American public, the land of romance and mystery—the home of poets singing in Persian gardens to the accompaniment of bulbul birds and tinkling fountains . . . We are fortunate in that that old-new Iran is here interpreted to us by a physician who has both unusual ability to observe and the judgment to evaluate such observations in the light of acquired knowledge and experience," wrote Hugh S. Cumming, Surgeon-General of the U. S. A. (retired) who did the Foreword. The book is illustrated and is decidedly worth while.

* New York, 1940. Funk and Wagnalls Company.

The American Journal of Surgery

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A PRACTICAL JOURNAL BUILT ON MERIT

NEW SERIES VOL. LIII

SEPTEMBER, 1941

NUMBER THREE

Editorial

A WAY OF LIFE, AND "I AM AN AMERICAN"

INSTEAD of writing on some phase of a surgical problem or discussing the newer economic threats to the profession we quote from two articles reported in the *New York Herald Tribune* (July 9, 1941). We predict that both John D. Rockefeller's "principles . . . which I learned at my mother's knee," and the letter of an unidentified resident of Missouri received by President Roosevelt will be given wider circulation in many publications.

John D. Rockefeller, Jr., in a radio broadcast opening the drive for the United Service Organization, listed among other things, "the principles in which my father believed and by which he governed his life. . . . They point the way of usefulness and happiness in life, to courage and peace in death. . . . Let me state them:

"I believe in the supreme worth of the individual and in his right to life, liberty and the pursuit of happiness.

"I believe that every right implies a responsibility; every opportunity, an obligation; every possession, a duty.

"I believe that the law was made for man and not man for the law; that government is the servant of the people and not their master.

"I believe in the dignity of labor, whether with head or hand; that the world owes no man a living but that it owes every man an opportunity to make a living.

"I believe that thrift is essential to well ordered living and that economy is a prime requisite of a sound financial structure, whether in government, business or personal affairs.

"I believe that truth and justice are fundamental to an enduring social order.

"I believe in the sacredness of a promise, that a man's word should be as good as his bond, that character—not wealth or power or position—is of supreme worth.

"I believe that the rendering of useful service is the common duty of mankind and that only in the purifying fire of sacrifice is the dross of selfishness consumed and the greatness of the human soul set free.

"I believe in an all-wise and all-loving God, named by whatever name, and that the individual's highest fulfillment, greatest happiness and widest usefulness are to be found in living in harmony with His will.

"I believe that love is the greatest thing in the world; that it alone can overcome hate; that right can and will triumph over might."

"These are the principles, however formulated," he said, "for which all good men and women throughout the world, irrespective of race or creed, education, social position or occupation, are standing, and for which many of them are suffering and dying.

"These are the principles upon which alone a new world recognizing the brotherhood of man and the fatherhood of God can be established."

The writer of the following letter to President Roosevelt is an American citizen of Czechoslovakian ancestry. He outlines the reasons why he was pleased with his citizenship, as follows:

"Dear President Roosevelt:

"I am a married man twenty-eight years old; a boy, three, and a girl, one. Here's how I feel about being an American.

"My ancestors were Czecho-Slovakians, my wife's English; but we're Americans.

"I look at my refrigerator, my oil heater and my radio. I'm glad I'm an American.

"My children get cod-liver oil, nourishing food and a doctor's watchful care. They'll be glad they're Americans.

"This morning I went to church. Amongst my neighbors, unafraid and unmolested, I thanked God for giving us America.

"I went home to my wife and kiddies. My little boy, Douglas, came running and said, 'Hi, pop. You gonna take me to see the ribber?' and I said, 'Sure Doug, I'll take you to see the river.' 'And we'll stand on the bridge and see the car cars, pop?' 'Sure, Doug.' 'Pop, see the sun.

Look, see, pop. It shine in the car car's window.' 'Yes, Doug, the sun's shining on all America.'

"After our walk we came home and sat down to veal chops, baked potatoes, fresh green beans and corn on the cob. I said grace with tears in my eyes. I'm so happy I'm an American.

"This afternoon we listened to a radio rebroadcast of British children, here in America, talking to their parents in England, and I was proud to be an American.

"Tomorrow I'll go to work. I work in an electrotpe foundry, and I love my job. I made it, in fact, from errand boy to production manager in two years. I had ideas and I told the boss about them. He's an American.

"Tonight, before going to bed, I told my wife, 'Honey, I'm going to buy a large flag and hang it out the window Friday. The President wants every one to pledge allegiance to a new and united America. And, honey, I'm going to do my part, because I'd rather be an American than anything else on earth.'"

After reading Mr. Rockefeller's "principles" and the above letter, we somehow felt better away down inside, and for this reason we rebroadcast them to you.

T. S. W.



Original Articles

PERFORATIONS OF THE INTESTINE BY INGESTED FOREIGN BODIES*

REPORT OF TWO CASES AND REVIEW OF THE LITERATURE

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INTRODUCTION

THE ingestion of sharp indigestible foreign bodies is not a rare occurrence and in the great majority of instances the object proceeds uneventfully through the intestinal tract. Carp¹ has reported the gastroenteric history of forty-eight cases of ingested foreign bodies, ranging from pins and nails to needles, fishbones and sharp screws. He found that 83 per cent passed harmlessly through the intestinal canal. In a certain percentage (17 per cent) of the cases, however, the foreign body becomes lodged in some portion of the intestinal tract, and sooner or later a perforation may occur.

The present paper analyzes ninety-three cases of intestinal perforation by ingested sharp foreign bodies, collected from the literature, and adds a report of two recent cases. In one of these latter, the foreign body perforated a loop of gut while it lay incarcerated in a hernial sac—a rare occurrence which has been reported in only five of the ninety-three cases found in the literature. In the second case, the perforation was of a more common variety but illustrates many typical features.

CASE REPORTS

CASE 1. No. 20499. A sixty-seven year old, married American housewife entered the hospital complaining of cramp-like pain in her

abdomen and a "lump" in her left groin of one week's duration.

Present Illness. The patient had been entirely well until five months before admission when she noticed a soft, reducible, nontender mass in her left groin. Two weeks before admission it reappeared and since that time had been tender and hard. Seven days before admission she began to suffer midline, lower, abdominal cramps with some obstipation. This was followed by incessant vomiting. She had passed no stool and very little gas during the last two days before her admission. There were no urinary symptoms.

Physical Examination. The patient was a thin, elderly, moderately dehydrated woman, in some pain. Pulse 88, temperature 99.4°F, respirations 20. Her chest was symmetrical and the heart and lungs were normal. Her blood pressure was 150/80. There was moderate soft distention of the abdomen with active peristalsis. In the left inguinal region there was a firm, tender, lemon-shaped mass, 5 by 3 cm. in size. It seemed slightly elastic, was not movable or reducible, did not transilluminate and was dull to percussion. The subcutaneous tissues overlying this mass seemed slightly discolored and cyanotic. There was no impulse or fullness at the femoral ring on either side. Pelvic and rectal examinations revealed no further pathology. The peripheral reflexes were equal and physiological though slightly diminished.

Laboratory Data. Blood: hemoglobin, 87 per cent; red blood cells, 5.08; white blood cells, 8,050, polymorphonuclears, 67 per cent. Urine: Color, cloudy amber, specific gravity, 1.022; reaction, acid, sugar and acetone, negative,

* From the Department of Surgery, Mary Imogene Bassett Hospital, Cooperstown, New York.

albumin, slightest possible trace. Microscopic examination, negative. Stool: The guaiac test was positive.

Diagnosis. Left indirect inguinal hernia; strangulation of intestine due to hernia.

The patient was given preoperative fluids parenterally. A gastric lavage and preparations for a transfusion were carried out while the operating room was prepared.

Operation. The inguinal region was explored under local anesthesia. The mass was found to consist of indurated fascial layers covering an indirect congenital sac in which a loop of small intestine was strangulated. The section of gut lying in the sac was dark and cyanotic with greatly indurated walls. It presented a small perforation on its convexity through which a section of wire 3 cm. long protruded. (Figs. 1 and 2.) Specimens taken from the fluid lying within the sac were negative on smear but later culture yielded a colon aerogenes organism. The intestinal lumen was so obstructed by the inflammatory reaction and the viability of this section of gut so questionable that a resection was thought advisable. An end-to-end anastomosis was carried out and the wound closed in layers without drainage.

Postoperative Course. Except for an elevation of temperature during the first few days the postoperative course was uneventful. Despite the positive culture obtained from the fluid in the hernial sac the wound healed without gross infection. She left the hospital on the nineteenth day and has continued in good health.

CASE II. No. 18528. A sixty-five year old, white American farmer entered the hospital with a chief complaint of generalized abdominal pain of forty-eight hours' duration.

Present Illness. About forty-eight hours before admission he was seized with a sudden sharp pain in the right lower quadrant of his abdomen which was sufficient to double him up and force him to grunt with pain. This pain persisted unabated for five hours and then gradually eased up a little. There was no nausea or vomiting. The pain radiated to the back and penis but was not accompanied by urinary symptoms. The discomfort continued throughout the next day. He had one bowel movement and ate two meals without distress. After a second sleepless night he entered the hospital for diagnosis and treatment.

Physical Examination. This farmer was a pale, thin, middle aged man lying quietly in

bed with his knees flexed. Pulse 100, temperature 101.2°F., respirations 28. The chest was symmetrical, the heart was of normal size and position without any murmurs; the blood pressure was recorded as 130/70. Abdominal examination revealed some tenderness throughout all quadrants with rebound tenderness referred to the right lower quadrant and spasm over the entire right half of the abdomen with an area of exquisite tenderness just medial to McBurney's point. Rectal examination revealed tenderness on both sides of the pelvis. The extremities were normal and reflexes physiological.

Laboratory Data. Blood: hemoglobin, 90 per cent; red blood cells, 4.77; white blood cells, 11,250; polymorphonuclears, 71 per cent. Urine: color, cloudy yellow, specific gravity 1.017; reaction, acid, albumin and sugar, negative, microscopic examination showed rare white and red blood cells.

Diagnosis. Acute appendicitis.

Operation. The abdomen was opened through a low right rectus incision. The cecum appeared to be the most indurated organ, the appendix appearing much less injected and only secondarily involved. After removing the appendix more careful exploration revealed a small, well walled-off perforation of the lateral wall of the cecum through which a toothpick was protruding. (Fig. 3.) The foreign body was removed, the perforation sutured, a drain inserted and the abdomen closed. A culture taken from the lateral wall of the cecum was oddly enough sterile under both aerobic and anaerobic conditions.

Postoperative Course. He ran a relatively mild course throughout his convalescence. The drains were removed on the eighth day and the wound closed spontaneously before his discharge on the twentieth day after operation. Since leaving the hospital he has been seen on one occasion. At that time he presented no hernia or weakness in his wound and was complaining of no gastrointestinal symptoms. In retrospect he declared he could not recall having swallowed the toothpick.

REVIEW OF THE LITERATURE

Ninety-three cases* have been collected from the literature as suitable for study.

* Cases of perforation by ingested blunt foreign bodies have not been included because it is usually impossible to be certain of the primary rôle of the foreign body in the evolution of the pathology. Viz: one

Of these, thirty-two were analyzed by Mitchell² who wrote an excellent paper on the subject in 1899. Since that time sixty-

tively (Fig. 5.) In only one case did the patient have any knowledge of the ingestion of the foreign body.

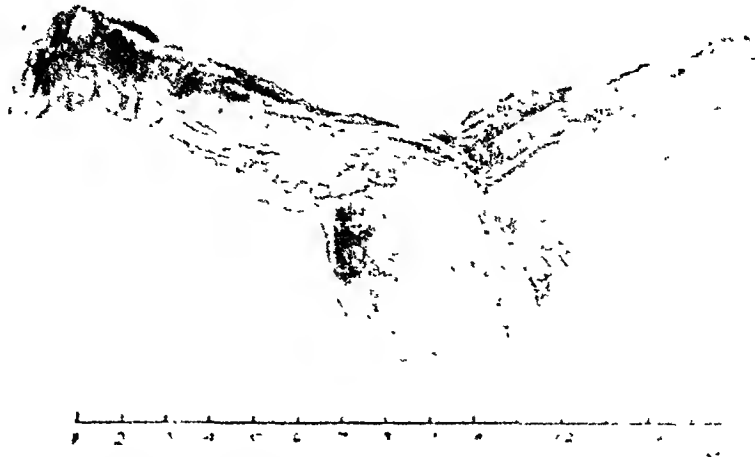


FIG. 1. Case 1. Photograph of the portion of small intestine resected at operation. The rounded mass in the center is the indurated, inflamed loop of intestine that had been incarcerated in the hernial sac. The perforating object (a small wire, not shown in the photograph) was found protruding from the center of the incarcerated mass.

one cases have been collected by other authors³⁻⁵⁴ which with the two reported in this paper make up the total of ninety-five. While an attempt has been made to collect all the cases reported, it is doubtless true that some may have been overlooked. Many cases occur which are not reported. Others are presented in such a fragmentary manner that one is not able to include them in an analytical study. It will be noted that a different number of cases is used for analysis under the several headings presented; this is due to the fact that the histories have not in every case afforded complete information.

Age. Although it is true that approximately 50 per cent of the cases appear in the first three decades of life, only 18 per cent of the cases were found in the first decade. The third and fifth decades were responsible for 17 per cent each of the total number of patients. The second, fourth, sixth, seventh and eighth decades had a decreasing percentage of the total, respec-

Sex. The sex was mentioned in eighty-seven cases. Fifty-one were males and thirty-six females. Except for the third

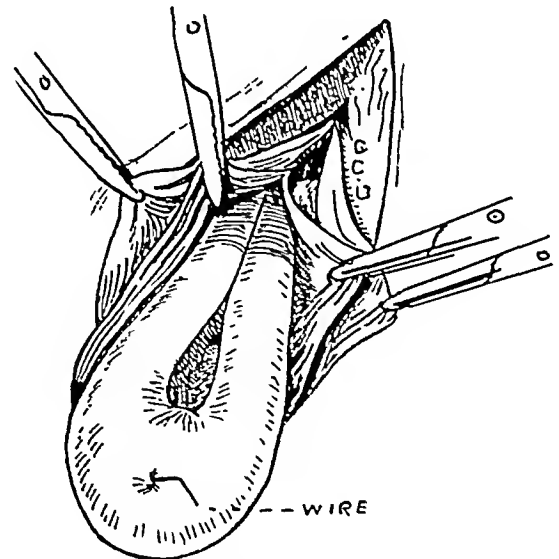


FIG. 2. Case 1. Diagrammatic sketch showing the loop of intestine as it appeared after the hernial sac had been opened. The small crooked segment of wire can be seen protruding from the distended portion of the loop. (See Figure 1.)

occasionally sees grape seeds and fecoliths, etc., which are associated with perforating lesions of the appendix, but one usually feels that the inflammatory process was primary and the perforation secondary even though the object may have initiated the process by obstruction.

decade of life the relative proportion of males and females runs evenly throughout the decades. (Fig. 5.) The great disproportion between the sexes in the third decade is not easily explained.

Types of Foreign Bodies. The objects found in this study can be classified into three broad groups. The first group is com-

posed of a lark, Hawkyard and Armitage³ report a rabbit's rib, Ackerman⁹ a pork bone, Carp¹ a bird bone, Garberson¹⁰ a porcupine

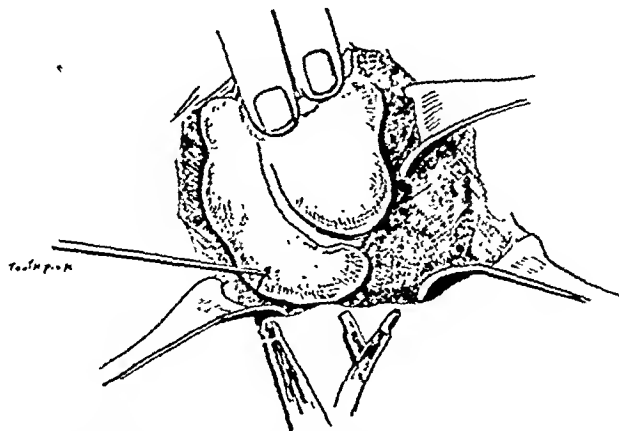


FIG. 3. Case 11. Diagrammatic sketch showing the approximate point of perforation of the wall of the cecum by the toothpick.

posed of metallic bodies, under which may be included pins of various descriptions and segments of wires. Animal bones, comprising fishbones and chicken bones, and also a wide variety of fragments of bony spicules ranging from portions of a rabbit's rib³ to teeth⁴ make up the second group. Wood splinters, including toothpicks and in one case the portion of a pencil were responsible for the remainder of the perforations.

Among the entire group of foreign bodies the metallic objects numbered 45 or 46 per cent of the total. J. F. Mitchell's² excellent review of a series of perforations due to the common pin has materially increased the percentage of this type of foreign body. The pins varied from ordinary household varieties to hairpins and needles.⁷ Six cases of perforation due to segments of wire were discovered in this series. One of these is represented in the case reports at the beginning of this article.

Segments of various types of bones were found in thirty-nine cases. In twenty-six members of this small group the perforations were due to fishbones, which seems natural since fish is a common food. Chicken bones were responsible for only four cases. In the remainder of the cases in this group an interesting collection of bony objects were found. Poulet⁸ reports the foot

quill, Matyas¹¹ a goose bone and duck bone, Porzelt⁵ a hen's rib, and Meyer and Rossi⁴ reported three cases due to the perforation of the intestine by teeth.

Toothpicks and wood splinters of various sorts caused perforations in nine cases or 9 per cent of the whole group.*

Sites of Perforation. The site of perforation was stated exactly in eighty-eight cases (Fig. 4.) The cardio-esophageal junction, the pylorus and the natural angles in the first and second portions of the duodenum provide both relatively fixed points and considerably narrowed passageways. Though one might expect the greatest number of perforations just proximal to these fixed points, very few perforations were reported at these sites. The gastric, duodenal and jejunal regions accounted for but five cases. The great preponderance of perforations of the lower ileal and cecal regions is striking. Excluding the large group which occurred in the appendix and in Meckel's diverticulum, there were twenty perforations in these regions.

Appendiceal perforations were found in thirty-four cases. A number of interesting facts are revealed in this small group. The first recorded case of an appendectomy on a living subject arose in connection with a

* Case 11 belongs to this group.

perforation of the appendix by a foreign body.*

In addition to the case described briefly in the footnote and that reported by the author in the present study there have been four other cases of perforation of the intestinal tract by foreign bodies while the gut was caught in an hernial sac. Four of these cases were perforations of the appendix and two were perforations of the ileum.

Meckel's diverticulum was a frequent site of arrest and subsequent perforation of the sharp foreign body. R. C. Webb¹³ collected six cases. Four others are reported by Donovan⁶ Lindqvist¹⁴ and Blanc.¹⁵

The colon was perforated fifteen times. The hepatic flexure accounted for three, the transverse colon one, the splenic flexure two, the descending colon one, the sigmoid five, and in three cases the site of perforation was not stated. The rectum was the site of penetration in three more cases.

In the seven cases in which the exact site of perforation was not known, the foreign bodies were found lying within abscesses in various recesses of the peritoneal cavity. In each of these cases, no visible perforation was detectable on careful inspection of the walls of these abscesses.

Duration of Symptoms. This phase of the subject was difficult of accurate appraisal. The duration of symptoms was stated definitely in seventy-four of the histories. Fifty patients in this series had had symptoms ranging from three hours to two weeks. In the remaining twenty-four cases the histories ranged from two weeks to twelve years in length. An attempt to relate the site of perforation to the duration of symptoms led to the conclusion that there was no relation between these two factors. The patients presenting the short

histories were not found to have had their perforations in any particular region of the intestinal canal.

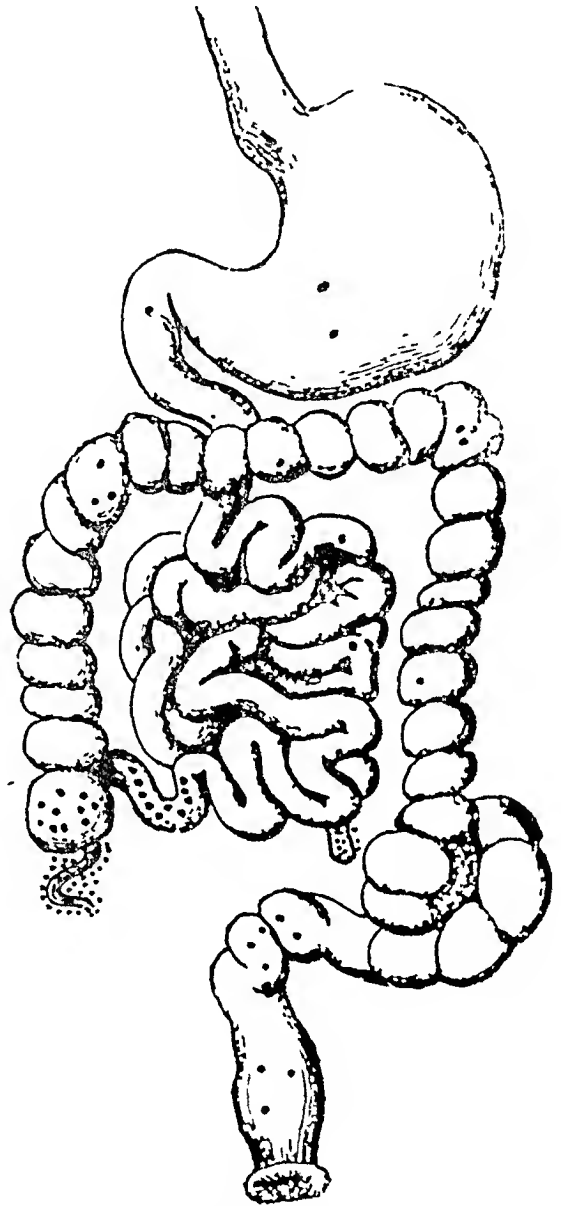


FIG. 4. Chart showing site of perforation in eighty-three cases studied. (In the remaining twelve cases the location was not specifically stated.) Each dot represents a perforation, the numbers being as follow:

Stomach	2
Duodenum	1
Jejunum	2
Meckel's diverticulum	10
Ileum	10
Cecum	10
Appendix	33
Colon	
Hepatic flexure	3
Transverse colon	1
Splenic flexure	2
Descending colon	1
Sigmoid	5
Rectum	3

* Amyard Claudius, in 1-35, is quoted by Deaver¹² as having seen a boy of five years of age for a discharging sinus of the right thigh of many years' duration, which had been accompanied by an irreducible scrotal hernia. In the course of a very difficult operation he came upon the appendix wrapped in omentum lying in a hernial sac. The appendix had been perforated by a pin the head of which lay in the appendix encrusted with fecal contents. The appendix was removed and the boy made a protracted recovery.

Types of Symptoms. There were two types of histories. The one was dramatic. Patients complained of a sudden, sharp type of symptoms have followed one of the above patterns though there were individual cases with rather bizarre lengthy

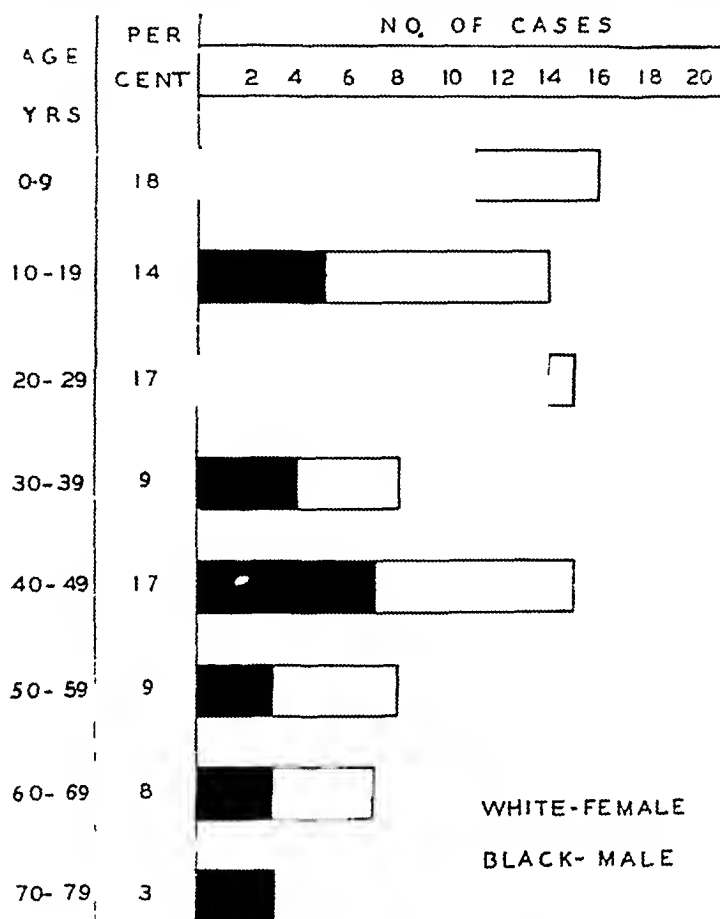


Fig. 5. Chart showing distribution according to age and sex of the ninety-five cases reviewed.

midabdominal pain which remained constant and severe and was usually accompanied by vomiting. If untreated, the picture in this type of case rapidly developed into that of a general peritonitis. The element of shock which is so often found in the early stages of a perforated gastric or duodenal ulcer was not described. These cases were, no doubt, associated with a sudden perforation of the intestinal tract with immediate soiling and subsequent infection of the peritoneal cavity. The other history related a more gradual onset of abdominal pain with low grade fever, anorexia and localized tenderness. As the days passed the patients developed the clinical picture of a localizing intraperitoneal inflammatory mass. In general the

stories. In the three rectal cases tenesmus, diarrhea and bloody stools were encountered with regularity. Perirectal infection with its attending pain, perineal edema, fever and anorexia were constant findings.

Pathology and Complications. In discussing the pathology subsequent to the perforation of the intestinal tract by sharp foreign bodies we find it quite easy to classify the cases into several groups depending upon the relation between the suddenness and quantity of the contamination of the peritoneal cavity and the ability and speed with which the defensive forces within that cavity can be mobilized. Ninety-three of the ninety-five cases in this review afforded a history sufficient to determine the type of pathology present.

The cases fall into five groups: (1) Early localized peritonitis; (2) indurated inflammatory tumors; (3) abscesses; (4) general peritonitis, and (5) hemorrhage.

Group 1. Early Localized Peritonitis. Seventeen cases fall into this group. Here usually the acute perforation was small, the foreign body was often metallic and found plugging the perforation. A local peritoneal reaction developed consisting of light fibrinous adhesions glueing the intestinal coils together about the site of perforation. In all but two of the instances the segment perforated was found to lie in the region limited by the ileum and cecum.

Group 2. Indurated Inflammatory Tumors. There were fourteen cases of this type. They were characterized by the presence of an inflammatory mass of indurated omentum and visceral peritoneum, which had effectively walled off the perforating agent and in which no actual purulent fluid had formed. Poulei⁸ holds that this type of reaction represents the first phase in the life history of migratory foreign bodies. He suggests, that the object may tend to work its way anteriorly toward the abdominal wall causing moderate induration of opposing intestinal loops and parietal peritoneum. Eventually the foreign bodies may reach the abdominal wall where they are either surrounded by indurated fat and fascia or are actually found lying in a small abscess.

Group 3. Abscesses. There were forty-two cases in this series which developed abscesses subsequent to the perforation. One was situated in a hernial sac and three in the perirectal tissues. Four cases in this group appear to be examples of a migratory type of pathology. Durman and Beltz¹⁷ reported a case of an abscess of the abdominal wall in a forty-eight year old woman in which a toothpick was found lying free in the abscess cavity. Mitchell's review² contains the histories of three individuals in whom a chicken bone and fishbones were found in abscesses of the abdominal wall. Five of the remaining thirty-four cases in this group afforded no evidence at opera-

tion or at autopsy of the actual site of perforation. Eighteen cases were described as right lower quadrant abscesses secondary to perforations of the cecum, appendix and ileum. In addition to developing intraperitoneal abscesses about the site of perforation six cases were associated with hepatic abscesses. This represents an incidence of 6.4 per cent of hepatic abscess in the entire series. As one might suspect, these cases presented long histories extending from one to sixteen weeks during which the primary focus had remained as an undrained abscess. The extension of the infection to the hepatic parenchyma was usually detected at autopsy. These six cases are contained in Mitchell's² report, which was written in 1899. During the latter decades of the nineteenth century a conservative attitude toward abdominal exploration was prevalent, even though the development of the modern era of surgery had already begun in larger clinics. A review of these early cases allows us to observe the dire consequences of permitting localized, suppurative intraperitoneal lesions to remain undrained for long periods of time.

Three cases in this group (abscesses) or 3 per cent of the entire series developed fecal fistulae. The low incidence of postoperative fistula is surprising when one realizes that no opportunity was afforded the operator to suture accurately the perforation in this group. There were no cases of fistula found in any of the other groups. Of the three fistulae encountered one closed spontaneously in three or four weeks, another required surgical closure and the third was found in a patient who succumbed to the effects of sepsis and toxemia.

Group 4. General Peritonitis. Eighteen cases of general peritonitis were found. Two of them were due to perforations of the sigmoid and one of them to perforation of the jejunum. The remainder of the cases were distributed throughout the lower ileal and cecal regions. Nine cases in this group were caused by metallic foreign bodies; in the remainder, bony and wooden objects were responsible for the catastrophe. No

relation between age and the development of peritonitis was detected. This calamity occurred both in youth (age $7\frac{1}{2}$)¹² and in old age (age 66)¹⁸.

Group 5. Hemorrhage. Only one case of this type was discovered. Wolfen and Liebli¹⁹ reported a case in which a fish-bone perforated the gastric wall and in so doing pierced a large branch of the right gastric artery causing rapid death.

Mortality. Omitting two cases in which the final outcome was not stated, we have ninety-three cases from which to estimate the gross mortality of the series. There were twenty-four deaths or a total mortality of 25.9 per cent.

If one divides the cases which terminated fatally into those occurring before and those after 1900, an interesting comparison develops. This date is an arbitrary one but affords some dividing line between the surgical periods represented in this review.

The period before 1900 contains thirty-three cases. Mitchell's series² contains thirty-five cases of which thirty-two are included in this report. Seventeen of these patients died. Mitchell published his paper in 1899. This fatal group together with one reported to have occurred in 1691²⁰ constitute eighteen deaths in this period or a mortality of 53.5 per cent. Practically every fatality in Mitchell's series had occurred without surgical intervention. Those patients in his series who survived did so usually because abscesses either drained spontaneously or did not require entrance into the general peritoneal cavity for their approach.

In the period 1900 to 1940, there were sixty cases. Six of these patients died, producing a mortality of 10 per cent. Four of this group had succumbed to general peritonitis. It is in this pathological group that little can be accomplished in an operative manner once the general infection has developed. There is little doubt that early operation in an acute abdominal emergency, the satisfactory drainage of the localized intraperitoneal abscess at the optimum time and the more careful atten-

tion toward preventing and combating abdominal distention, dehydration, loss of protein, electrolytic imbalance and vitamin deficiency in these desperately sick patients have been effective. The marked difference in the mortality of the two groups, 53.5 per cent in one and 10 per cent in the other, affords one a means of measuring our progress in the early recognition and effective treatment of acute peritoneal inflammation and infection.

The relation of mortality to the type of pathology is an interesting one. The group in which a local peritoneal inflammation or an indurated inflammatory mass was found had no deaths in either of the surgical periods. Those, however, with abscesses and generalized peritonitis showed a striking improvement in their mortality figures for the period after 1900. While before 1900, patients in the abscess group showed a 52.6 per cent mortality, since 1900 the mortality of patients in this group has dropped to 8.7 per cent. We must remember that in the former group (before 1900) there were a number of complicating pathological features which operated toward increasing the mortality. Multiple and disseminated abscesses were found in seven of these fatal cases. Cases which developed peritonitis before 1900 universally died, whereas those suffering from this disease from 1900 to 1940 showed a mortality of only 36 per cent.

SUMMARY

A report in detail of two cases of perforation of the intestinal tract by ingested, sharp, foreign bodies has been presented. In one instance the perforation occurred in a loop of intestine lying incarcerated in a hernial sac. The other case was a perforation of the cecum by a toothpick. Ninety-three cases have been collected from the literature and studied. The following points were brought out:

1. The types of foreign bodies ingested included metal objects such as pins and wires; bony objects such as chicken or fish

bones; wooden splinters; and other bizarre pointed bodies.

2. Seventy-three per cent of the perforations occurred in and around the ileocecal region, the remainder being distributed generally from the stomach to the rectum.

3. Six cases of perforation of the intestine with a hernial sac were reported.

4. Duration of symptoms ranged from a few hours to two weeks in 50 per cent of the cases. The remainder of the cases had longer histories.

5. Types of pathology observed were classified into five groups: early localized peritonitis, inflammatory masses, abscesses, general peritonitis and hemorrhage.

6. The mortality in respect to the surgical period before and after the year 1900 shows a 53.5 per cent mortality in the former period and 10 per cent in the latter.

TABLE I
TABLE INDICATING RELATION OF TYPE OF PATHOLOGY TO
MORTALITY IN THE PERIODS BEFORE AND AFTER THE
YEAR 1900
Before 1900, 32 cases

Type of Pathology	Number of Cases	Deaths	Mortality, Per Cent
Abscesses.....	19	10	58.8
General peritonitis.....	7	7	100
Inflammatory masses....	3	0	0
Local peritonitis.....	3	0	0
After 1900, 59 cases			
Abscesses.....	23	2	8.7
General peritonitis.....	11	4	36
Inflammatory masses....	11	0	0
Local peritonitis.....	14	0	0

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FRACTIONAL SPINAL ANESTHESIA*

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SPINAL anesthesia has undergone many improvements since its discovery in this country by Corning¹ in 1885. Gradually many of its undesirable features have been eliminated or altered so as to make its beneficial characteristics more applicable clinically. The clinical use of spinal anesthesia really began in 1889 when Bier,² of Germany, injected cocaine intraspinally in man. With its introduction, anesthetists were immediately confronted with the need for a means of preventing the untoward reactions produced by spinal anesthesia, that is, toxic manifestations of cocaine and depression of circulation. Epinephrine was isolated in 1901 by Takamine,³ and in 1903 its vasoconstrictor properties were applied to local and spinal anesthesia by Braun,⁴ of Germany. In 1905, the less toxic drug, procaine hydrochloride, was introduced by Einhorn.⁵ This drug made spinal anesthesia safer to use. The need for a vasoconstrictor of longer action than epinephrine was answered when in 1921 Chen⁶ introduced ephedrine sulfate, and by 1927 Ockerblad and Dillon⁷ and Rudolf and Graham⁸ were administering it preliminary to spinal anesthesia in order to prevent blood pressure fall. This drug was responsible for a renewal of clinical interest in spinal anesthesia as it gave prolonged vasoconstrictor action and prevented much of the blood pressure fall formerly associated with subarachnoid block.

Even with a relatively nontoxic agent—procaine and an adequate vasoconstrictor, ephedrine—there was still much to be desired clinically in spinal anesthesia. Satisfactory height and duration of anesthesia were difficult and sometimes impossible to obtain by a single injection of a previously determined dose of the spinal anesthetic agent. Consequently, many new spinal

anesthetic agents and method of administering them were introduced in an attempt to increase the controllability and duration of anesthesia. Soon the anesthetist had spinocaine, procaine, metycaine, pontocaine and nupercaine to choose from, with numerous methods of administration at his command. All too often, however, the anesthesia failed to develop, wore off sooner than expected or the operation took more time than was anticipated.

William T. Lemmon,⁹ of Philadelphia, has provided the most recent advance in subarachnoid block anesthesia with his introduction of fractional (continuous) spinal anesthesia. This method of producing prolonged spinal anesthesia employs a short acting agent, procaine hydrochloride, which is injected in fractional doses as needed during the operation. Continuous spinal anesthesia is made possible by placing the patient on a specially designed mattress and allowing a very flexible, German silver, lumbar puncture needle to remain *in situ* during the operation. (Fig. 1A.) The needle is connected to a syringe by means of a thirty inch piece of rubber tubing which is provided with Luer-Lok connections at either end, making the system air and water tight. (Fig. 2.)

The rubber covered mattress† employed is five inches thick, eighteen inches wide and six feet long. It has a cut out part seven inches in length which comes under the lumbar spine when the patient is supine. The mattress is divided in half so that the portion which supports the lower extremities may be detached for perineal operations. (Fig. 3.) If an abdominal operation follows the perineal procedure, the patient may be pulled back into position and the

† Manufactured by Geo. P. Pilling and Son Co., Philadelphia, Pennsylvania.

* From the Department of Anesthesia, The Lahey Clinic, Boston, Massachusetts.

lower half of the mattress replaced and made secure to the upper half with a strap and buckle. (Fig. 4.) Provision has also

We have employed as anesthetic agents procaine, nupercaine, metycaine and pontocaine.* Because of its shorter action, pro-

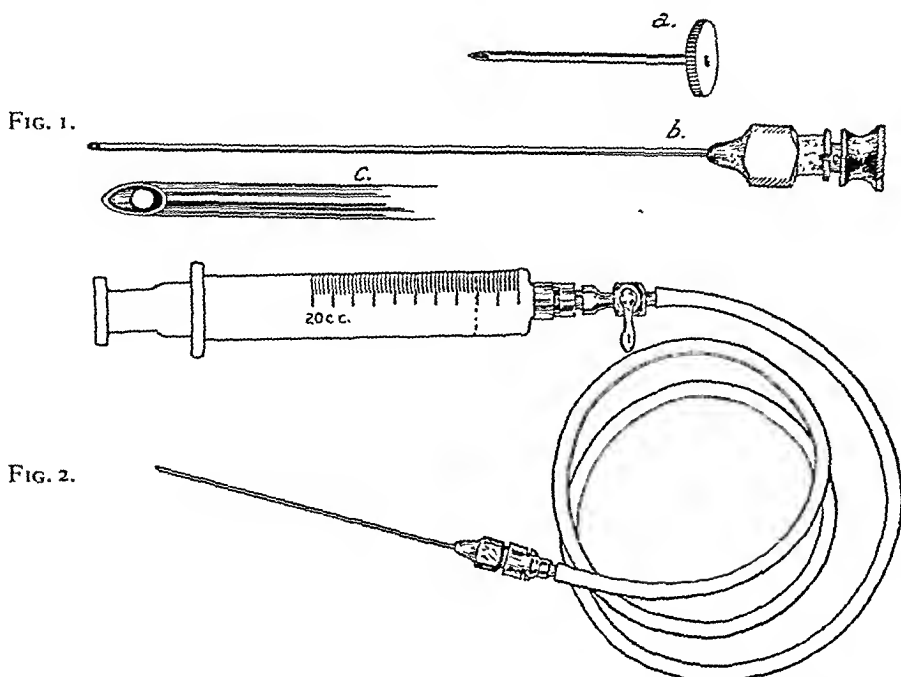


FIG. 1. a, Sise introducer; b and c, German silver needle showing hole through bevel to facilitate aspiration of spinal fluid.

FIG. 2. Syringe and needle connected to tubing by Luer-Lok connections.

been made to break the lower part of the mattress to allow the feet to be lowered when Trendelenburg position is desired. (Fig. 5B.) The shoulder braces require longer supporting irons to allow for the five inch thickness of this special mattress and the same may be said for the wrist restraints.

German silver needles possessing great flexibility are used and it will be noted from the illustration that these needles have a small hole through the bevel. (Fig. 1b and c.) This latter modification was made by Lemmon¹⁰ to insure a free flow of spinal fluid, and this has been of value clinically when it has been necessary to employ barbotage to get the proper height of anesthesia. The ability to withdraw spinal fluid informs the anesthetist that the needle is still in the subarachnoid space and makes it possible, if toxic symptoms appear early, to decrease rapidly the concentration of the anesthetic drug.

caine seemed particularly well suited to this method of administration and most of our experience has been with this drug. After trying 10, 7, 5, 4, 3 and 2.5 per cent solutions, we have found a $3\frac{1}{3}$ per cent solution in normal saline most satisfactory. This solution produces anesthesia in three to five minutes, and as each 3 cc. contains 100 mg., the calculation of the total amount used is simplified. In addition, it makes possible the use of a 4 to 5 cc. volume for induction without making the initial dosage dangerously high. Lemmon¹⁰ reports satisfactory results with procaine hydrochloride in over 500 cases of fractional spinal anesthesia, having in the early part of his series employed a 10 per cent and more recently a 5 per cent concentration of procaine in spinal fluid.

* The Lahey Clinic (Sise) pontocaine-glucose technic for spinal anesthesia with modifications is being used satisfactorily for fractional spinal anesthesia (*Surg. Clin. N. Amer.*, 15: 1501-1511, 1935). A report of our findings will be published in the near future.

The spinal puncture is made, using either an 18, 19 or 20 gauge German silver needle, with the patient in the left lateral decubitus

A 5 cc. ampule of 20 per cent procaine hydrochloride is diluted to 30 cc. with normal saline solution to make a $3\frac{1}{3}$ per

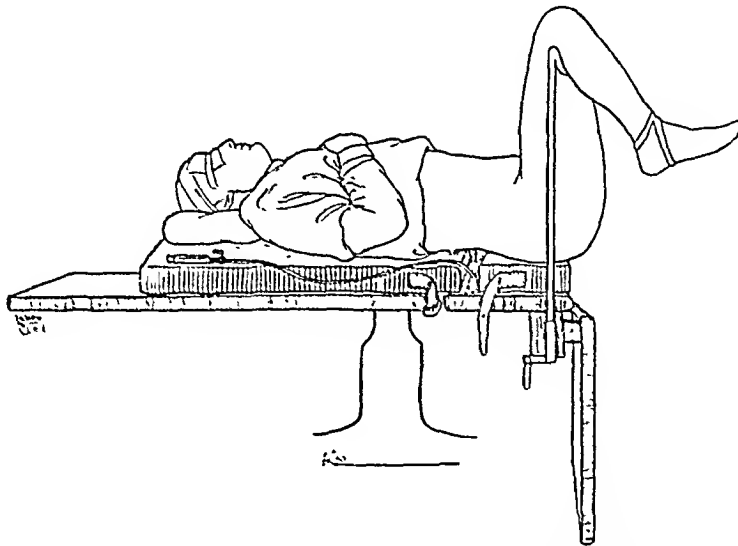


FIG. 3. Position of the patient on mattress for perineal operation, showing needle in place and lower part of mattress removed.

position so that the back is toward the side of the mattress with the opening in it. Routinely, 50 mg. of ephedrine sulfate is injected as part of the local anesthetic in the site selected for lumbar puncture. This selection depends on the operation contemplated. The lumbar interspaces used are: the second for upper abdominal proce-

cent solution, each 3 cc. of which contains 100 mg. After the 20 cc. Luer-Lok syringe and tubing have been rinsed with sterile normal saline solution, the syringe is filled with the $3\frac{1}{3}$ per cent solution and again connected to the stopcock which is attached to one end of a thirty inch piece of thick-walled, small bore rubber tubing.

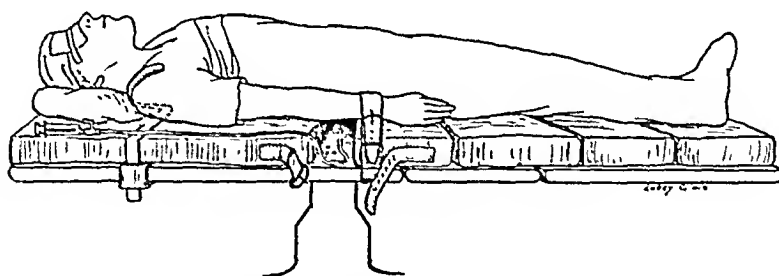


FIG. 4. Patient in position for abdominal operation. Needle in place and shoulder braces and wrist restraints adjusted.

dures, the third for lower abdominal and the fourth for operations on the rectum or lower extremities. A Sise introducer (Fig. 1a) is used to puncture the skin and superficial interspinous ligaments and on withdrawal leaves a track for the soft, flexible German silver needle to traverse. Once the needle has been successfully introduced and spinal fluid flows freely, anesthesia may be induced.

The stopcock is opened and 2 cc. of the mixture is forced into the tubing, thus displacing the air and completely filling the tubing. Then the stopcock is closed. The Luer-Lok connection at the opposite end of the tubing is securely connected to the needle which is left in the spine. (Fig. 6.) If on opening the stopcock the plunger of the syringe is forced out by the cerebrospinal fluid pressure, or spinal fluid can be

aspirated into the tube with ease, the spinal puncture is satisfactory.

With the needle in place and the tubing

tional injection, generally of 1 cc., is made. Since the specific gravity of the anesthetic solution is greater than that of spinal fluid,

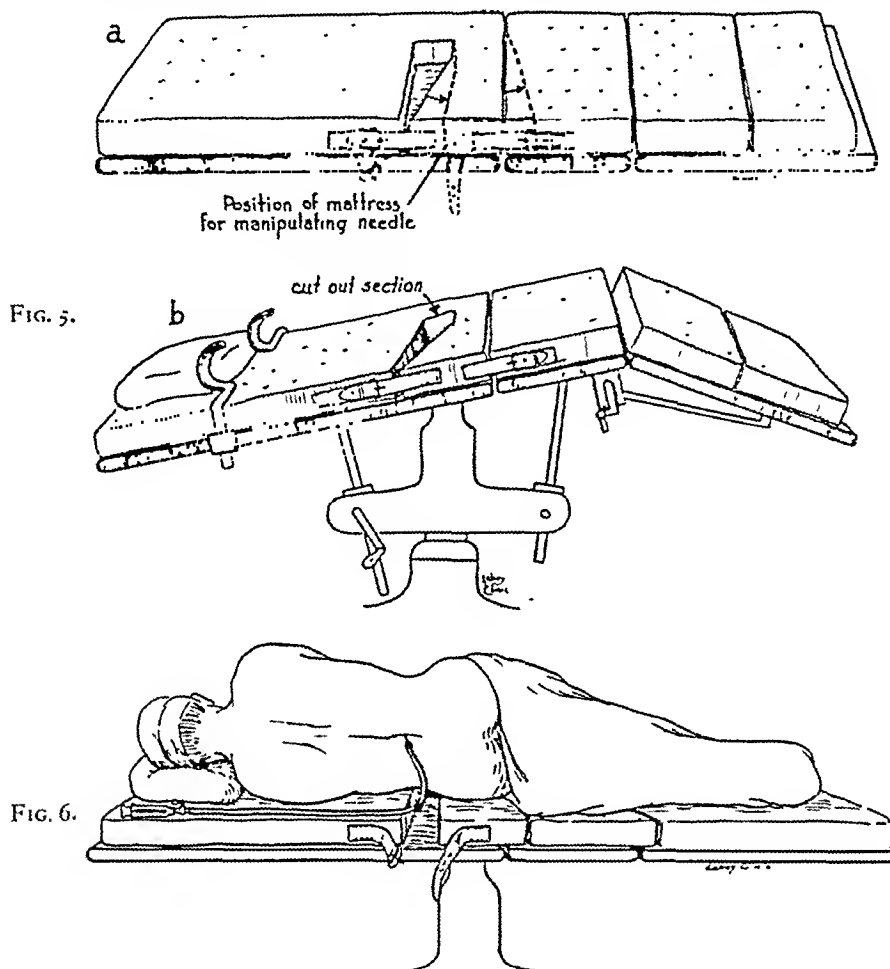


FIG. 5. a, design of mattress used for giving continuous spinal anesthesia, showing cut out section which prevents bending of the needle; b, position of mattress for operations in the Trendelenburg position.

FIG. 6. Patient in left lateral decubitus; needle in place and syringe and tubing connected.

connected, the patient is gently turned in the supine position and the needle is allowed to rest in the center of the gap in the pad, so that it does not touch the table or mattress at any time. (Fig. 3.) If complete abdominal anesthesia is desired, the patient is placed in a 5 degree Trendelenburg position for induction after the shoulder braces and wrist restraints have been properly adjusted. An initial injection of 2.5 cc. (85 mg.) to 3 cc. (100 mg.) of the mixture is made and the height of anesthesia tested after five minutes. If the desired level of anesthesia has not been obtained, an addi-

the factor of gravity as well as volume, barbotage and site of injection may be brought into play to obtain the desired height of anesthesia.

To familiarize ourselves with fractional spinal anesthesia, a group of cases requiring time-consuming operations on the lower extremities was selected. Gradually, as confidence was acquired and the merits of this type of anesthesia were demonstrated to the satisfaction of both surgeon and anesthetist, we included more difficult procedures and soon had covered the field of almost all operations below the dia-

experimentally in 1932 and Bourne¹⁵ clinically in 1939, has been very helpful in treatment of this hypotension. This mixture is preferred as it does not produce the tachycardia of epinephrine or the bradycardia of neosynephrin. On many occasions after a preliminary fall in blood pressure of 20 to 30 mm. of mercury during the first half hour of anesthesia, institution of the above mentioned treatment will cause the blood pressure to return to its preoperative level and remain there for the duration of the operation, provided there is no marked blood loss.

TABLE 1

	Cases*
Subtotal gastric resection for duodenal ulcer	22
Subtotal gastric resection for cancer	12
Total gastric resection for cancer	4
Exploration and biopsy, cancer of stomach	16
Operation on gallbladder or bile duct apparatus	3
Removal of retroperitoneal tumors	3
Mikulicz resection of colon	7
Abdominoperineal resection for carcinoma of rectum	9
Abdominoperineal resection for ulcerative colitis	1
Operation on small intestine	6
Excision of tumor of mesentery	1
Resection of duodenum and head of pancreas	1
Appendectomy	2
Orthopedic operations on femur, hip, knee, pelvis	6
Dilatation and curettage followed by abdominal surgery	9
Dilatation and curettage with question of abdominal operation	6
Operation on bladder	2
Ileocolostomy	3
Gastroenterostomy	2
Repair of hernia	2
Vaginal hysterectomy	1
Superficial operation on pelvis or extremities	4
First stage Lahey abdominoperineal resection	1
Sigmoidotomy for excision of polyp	1
Posterior resection of rectum	1
Abdominal adhesions	1
Total	126

* Fifty additional cases have been done recently, but are not included because follow-up reports are incomplete.

Once anesthesia has been established with this fractional method, the anesthetist can maintain it by periodically injecting small amounts of the anesthetic agent through the tubing attached to the needle. As anesthesia wears off during an abdomi-

nal operation and sensory and motor function starts to return, the patient complains first of vague discomfort and then of pain as the abdominal muscles grow tense. Just as one would add more ether under a similar circumstance to produce relaxation during inhalation anesthesia, when this occurs during fractional spinal anesthesia we give a small dose of procaine. The addition of 35 to 50 mg. is usually sufficient. It takes from thirty seconds to three minutes for the added dose to exert its full effect. After one has had some experience with fractional spinal anesthesia it is possible to administer these additional doses at fairly regular intervals and provide the surgeon with abdominal relaxation throughout the operation.

The physiologic reason for these small subsequent doses of procaine being able to prolong nerve blocks which originally required three or four times the amount of drug to produce seems to have been partially answered by Heinbecker¹⁶ and his co-workers (1932). Using procaine hydrochloride, "Patients were studied under low spinal anesthesia. The sequence of events was as follows: first, there was an early increase in skin temperature, after two or three minutes a loss of sensitivity to heat and cold, and then to cutaneous and pressure pains. The order of loss of these sensations was distinct, though only a brief time interval elapsed between their disappearance. Following a distinctly wider gap, loss of motor function occurred, then after another short interval, loss of joint sense, pressure sensation and touch. During recovery, the return of sensibility was in reverse order, and the gaps between the return of sensation much wider." Emmett,¹⁷ in a study of thirty-one patients receiving procaine intraspinally, found that motor nerve block occurred last and only when the dose of the drug was fairly large. One might suppose then that these small additions of procaine in fractional spinal anesthesia provide the necessary concentration of the drug in the spinal fluid to prolong the motor block and thus prevent the reversal

of the sequence necessary for recovery, as described by Heinbecker.

These observations seem to explain why Koster,¹⁸ using classical spinal, was able to produce a differential sensory block of sufficient height for operations about the head and neck. More recently Lemmon,¹⁹ using fractional spinal, has been able to produce anesthesia in patients undergoing thoracic surgery and still have the muscles of respiration in an apparently normal and functioning state. On the other hand, Dogliotti,²⁰ also interested in the supposed difference in the response of sensory and motor fibers to local anesthetic agents, says, "We have been unable to establish a typical dilution which serves to produce a block to sensation of pain without affecting motor function. When one is able to produce an appreciable analgesia with minimal doses, that is, 0.2 to 0.3 gm. of novocain in spinal fluid, one still does not have a disappearance of the thermic and tactile sensitivity, and muscular hypotonia is already observed." Dogliotti's work has been limited to classical spinal anesthesia, however, and we must reserve our impressions regarding the possibilities with fractional spinal anesthesia until more experience can be had.

A careful postanesthetic follow-up with neurologic complications in mind has revealed but two complications of this type, and these were transitory in nature. One was a severe headache lasting five days in a patient who gave a history of headaches for fifteen years prior to operation. The second patient complained of a sciatic type of pain which began about three weeks after operation but she reports that this has since subsided. We have not had an opportunity to examine this patient as she lives in another state and has not yet returned for her second stage operation.

We are particularly interested in this method of administering spinal anesthesia as it seems more readily controllable and physiologically sound than other methods. With the fractional injection intraspinaly of small doses of an anesthetic agent, we

are able more nearly to approach the flexibility and control which has long been one of the outstanding advantages of the inhalation method of administering anesthetic drugs.

SUMMARY AND CONCLUSIONS

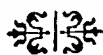
One hundred twenty-six cases are reported in which surgery was performed under fractional (continuous) spinal anesthesia. These include various types of operations below the diaphragm. Duration of the operative procedures varied in length from a few minutes to four and a half hours. Procaine, metycaine, nupercaine and pontocaine have been used as the anesthetic agent, with some minor variations in technic.

As a result of our experience, we believe that fractional spinal anesthesia is indicated in: (1) long, difficult operations such as subtotal gastric resection for ulcer, secondary operations on the biliary tract, and large bowel resections; (2) those cases of undeterminable length, such as abdominal exploration with question of gastric resection, dilatation and curettage that may be followed by hysterectomy and exploration with possible removal of retroperitoneal tumor. These indications will necessarily vary with each anesthetist and surgeon for whom the method is employed, as much depends on the type of procedure undertaken and speed of the operator.

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PEPTIC ulcers in the young may give rise to: (1) malnutrition and repeated gastric upsets; (2) exsanguinating and even fatal hemorrhage; (3) perforation into the general abdominal cavity; and (4) mechanical obstruction from cicatricial tissue near the pylorus. In general, the treatment for each of these various conditions should be much the same as that for older patients.

MALIGNANCY OF THE VULVA

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CANCER of the vulva should be readily diagnosed and if prompt treatment is instituted the end result should be most gratifying. Nevertheless, many of the patients who come for treatment present far advanced conditions. Frequently this is due to the negligence of the individual to seek early advice. Occasionally the fault lies with the medical attendant who does not recognize the early manifestations of this malady.

Cancer of the vulva comprises somewhere between 2 and 6 per cent of all cancers that occur in the female generative tract. Clark and Norris had thirty cases of vulvar cancer in 1,019 cases of genital malignancy, approximately 2.3 per cent. Schottlander and Kermauner found that between 2 and 4 per cent of genital cancers in women were located in the vulva. Dittrich states that 5.6 per cent of all carcinomas of the female genitalia are vulvar lesions. In 500 women that we have seen who had malignancy of the genital tract, seventeen occurred in the vulva, 3.4 per cent. The wide variation in the incidence of this disease compared to cancer arising in other sites in the genital tract may be due to the fact that most of the reported series of vulvar malignancies has been small.

The exact locations of the growth in our series were as follows: thirteen involved either the right or left labium and of these two also involved the clitoris. In four cases the growth apparently arose in the urethra. In many patients it is impossible to say definitely where the disease originated. In a collection by Ederle of 677 cases of vulvar cancer 109 began in the clitoris.

Our observation of cancer of the vulva coincides with that of cancer of other organs when the question of age is considered. We are seeing cancer of the cervix

and cancer of the breast more frequently in younger women today than we did twenty years ago. Taussig, in a very comprehensive article, states that cancer of the vulva is a disease of old age, that 60 per cent of the patients he observed were past sixty years of age and 30 per cent were seventy or older. A study of the ages of our patients reveals a striking contrast. We had one patient in the third decade, three in the fifth, five in the sixth decade, six in the seventh and two seventy years of age or older. The youngest patient was twenty-nine, the oldest eighty-two, the average age being approximately fifty-six years.

Apparently child bearing plays but little part in the causation of this disease. Of our seventeen patients six had never borne children. The social status of the individual, however, may play some part in the causation. This probably is only a matter of personal cleanliness as the disease is seen more frequently in the lower social strata.

In five of our seventeen cases there was a family history of malignant disease. In three instances two or more of the immediate family of the patient had died of carcinoma.

Leukoplakia is a very common precursor of vulvar cancer. In fourteen cases studied by Kerns four or a little more than 25 per cent originated in leukoplakia. In our series leukoplakia apparently preceded the development of carcinoma in four cases or approximately 25 per cent. One other case may have had leukoplakia preceding the onset of her malignancy. She came under observation late in the course of her disease with a history of a bloody vaginal discharge of fifteen months' duration. She had had syphilis but had been adequately treated.

The subjective symptoms of cancer of the vulva vary considerably. In the begin-

ning there is usually itching, burning and a stinging sensation followed by the appearance of a slight discharge. Bleeding is a

tastasis. At the time our patients were first seen there was glandular involvement in four individuals. In a fifth case the glands

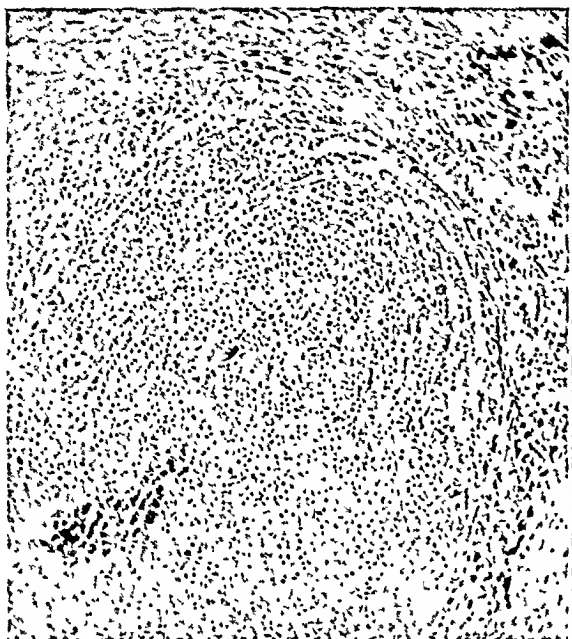


FIG. 1. A melanotic tumor arising in the skin of the labium majus. The cells are grouped in solid masses bounded by stroma. There are large dense masses of pigment.

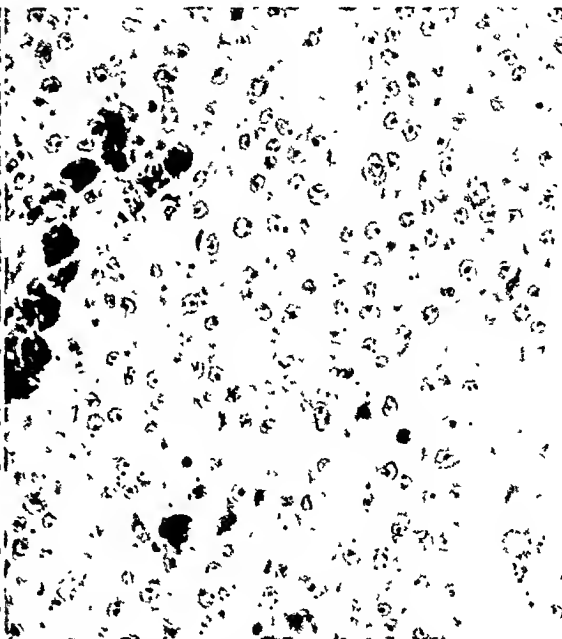


FIG. 2. Melanoma of the vulva. Cells are polygonal, a few are in mitosis. Numerous cells have many granules of melanin in the cytoplasm and there are also large, dense masses of intercellular pigment.



FIG. 3. Squamous cell carcinoma of the vulva. Irregularly shaped masses of squamous cells are infiltrating the corium and the subcutaneous fat. There is a moderate amount of fibrous stroma.

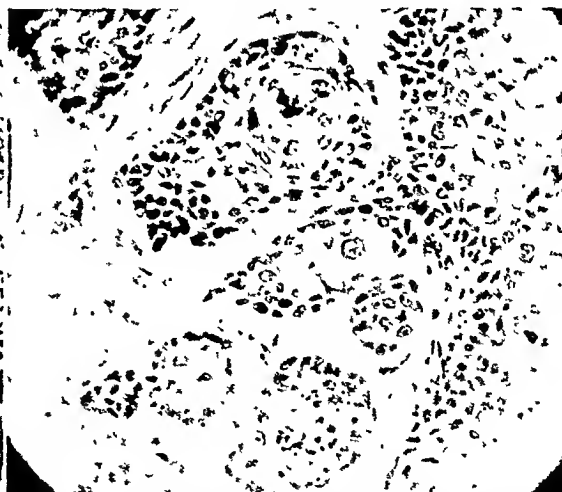


FIG. 4. Epithelial pearls are numerous; some of them have begun to break down. Cells are squamous in type, mitoses few.

common early symptom. This is especially true when the growth originates in the region of the urethra. The next most common symptom is the presence of a nodule in the labium. As the disease progresses ulceration occurs and later glandular me-

were enlarged but microscopic study of the excised tissue failed to reveal any cancer.

PATHOLOGY

By analogy, carcinoma of the vulvar region may have its origin in any one of the

various epithelial structures found there, and reports of all of them except the sebaceous glands have appeared in the literature.

do not have the structures of squamous cell tumors and their genesis is still in doubt.

Pre-existing and associated pathology consists of leukoplakia, kraurosis, mild

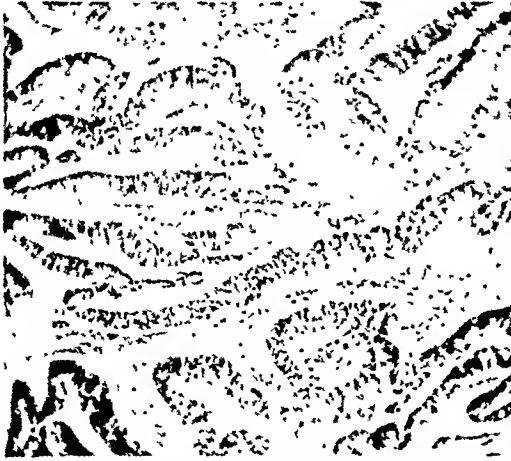


FIG. 5. Adenocarcinoma of the vulva arising in Bartholin's gland. There are imperfect glands and many papillae.

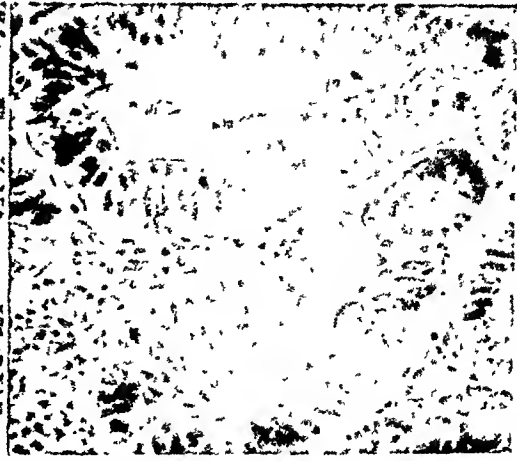


FIG. 6. The cells are columnar, multilayered and have varied polarity. Chromatin is abundant, mitoses numerous.



FIG. 7. Mrs. K., cancer of the vulva; operated upon in 1938; wide excision and gland dissection followed by deep x-ray therapy.



FIG. 8. Appearance of vulva two years after treatment. Vagina admits one finger. Figures 9 and 10 show microscopic appearance of excised tissue.

The mucosa of the labium majus, and minus, the clitoris, the urethra, and the surface covering of the skin of the labium majus give rise to squamous cell tumors. From the sweat glands and Bartholin's glands tumors with gland like structures made up of their characteristic cells develop. Melanin bearing cells, probably of nerve cell origin, in the skin of the labium majus produce the melanosis. These tumors

inflammation from pruritis, syphilis and psoriasis.

The squamous cell tumors are of three types grossly: (1) warty, or papillary, (2) ulcerative, and (3) diffuse infiltrations. The glandular tumors appear as deeper tumefactions. The pigmented tumor may be preceded by a colored "mole."

Malignancy of the vulva is usually high grade in a larger proportion than in similar

tumors elsewhere in the body. Metastasis occurs as a rule in the lymph-nodes of the groin, and locally about the primary tumor,

place. Also in early cancers seen in younger women simple local excision followed by radiation therapy gives good results and



FIG. 9. Squamous cell carcinoma of the vulva. Large epithelial masses with necrotic centers are infiltrating the subcutaneous tissue. In the stroma is a moderate inflammatory reaction.

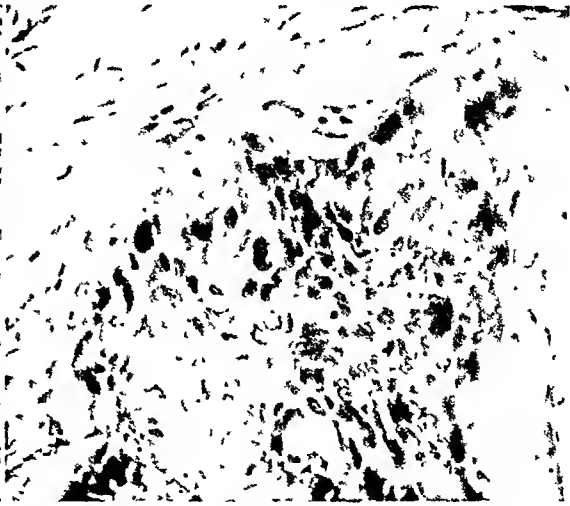


FIG. 10. Cells are squamous in type with irregular morphology.

in the abdominal wall, about the anus, and the skin of the thighs. Late in the course of the disease and in the more malignant instances, the postperitoneal lymph-nodes and all viscera of the trunk may be affected.

In our series there was one melanosarcoma, one adenocarcinoma arising in Bartholin's glands and fifteen squamous cell cancers, an incident of the latter of 88 per cent.

TREATMENT

Cancer of the vulva resembles in many respects cancer of the lip. Both spring from a transitional type of pavement epithelium. They tend to remain local for some time. In some cases the lesion is but slightly elevated and rather soft, others are firm, infiltrative and ulcerate early. As in the treatment of early lesions on the lip radium may be used to great advantage so also may it be used in similar types of cancer of the vulva. Radium alone should not be used in the infiltrative or deeply ulcerated type of growth. We do think that in the treatment of early cancer of the vulva in the aged or debilitated patient radium has a definite

obviates the mutilation incident to the wide removal of vulvar structures.

Radium is extremely valuable in the treatment of cancer arising in the urethral area. In this location wide excision is frequently followed by incontinence of urine. It is our practice to excise enough tissue for microscopic study and then thoroughly burn the growth with the electric cautery and later treat by local application of radium. The usual dose of radium we employ is 600 mg. hr. filtered through 1 mm. of brass and two layers of rubber dam. This can be repeated in six weeks if necessary.

Surgery is the treatment of choice in most cancers of the vulva. In the nodular type of lesion, the melanoma or the deeply ulcerated growth the excision should extend well beyond the involved area. This wide excision should be combined with the removal of the regional lymph-nodes. Frequently the nodes are found enlarged and palpable and yet not invaded by cancer. If the glands of the inguinal region are cancerous, the dissection should include not only the lymphatics of Scarpa's triangle but in

addition those within the inguinal and femoral canals.

In the more advanced cases of vulvar cancer, surgery should be supplemented by intensive deep x-ray therapy. Postoperative irradiation should also be employed in all cases in which the pathological gradation of the tumor is three or four. In one of our cases in which the growth had extended beneath the ramus of the pubic bone, wide excision and glandular dissection were combined with implantation of radium needles into the involved tissue. Each needle contained $2\frac{1}{2}$ mg. of radium filtered through $\frac{1}{2}$ mm. of platinum irradium. They were spaced $1\frac{1}{2}$ cm. apart and allowed to remain six days. (Figs. 5 and 6.) Later intensive deep x-ray therapy was employed. This patient is alive five and one-half years since treatment was completed.

RESULTS

Of the seventeen cases studied one could not be traced. Six patients are dead of their disease. Of these six patients one was a girl of twenty-nine years of age who had in addition to her vulvar cancer a papillary cyst adenoma of the left ovary. The cause of her death is not known but was probably due to cancer. One patient died of generalized metastases eighteen months after the removal of a malignant melanoma of the left labium. (Figs. 1 and 2.) Of the other four cases the disease had been present six months to two years before any treatment was instituted and in two there was wide spread, glandular involvement at the time the patients were first seen. One patient, aged seventy, lived four years following treatment and died of a recurrence.

Ten patients are alive and well, one for eleven years, one for eight and one-half years (Figs. 3 and 4), one for eight years, one for seven years and another for five and one-half years. (Figs. 5 and 6.) Of the five patients treated less than five years ago one is well four years and two are well and free of the disease two years since treatment. One is well eighteen months and the other, whose therapy on account of her advanced age and general condition consisted only of radium, is now living sixteen months since treatment. These figures show a five-year curability of cancer of the vulva of approximately 30 per cent.

SUMMARY

The incidence of vulvar cancer as compared to cancer elsewhere in the female generative tract is presented.

The age incidence is less than some observers have reported.

The pathology of the lesion is discussed. Eighty-eight per cent are squamous cell cancer.

A method of treatment is outlined and the value of radium therapy in certain types of lesions is emphasized.

The five year curability of vulvar cancer is about 30 per cent.

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SURGERY IN PATIENTS OVER FIFTY WITH OBSTRUCTING PYLORIC LESIONS

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PYLORIC obstruction in adults past fifty is commonly considered to be due to either a malignant growth within the stomach or one arising adjacent to it and blocking the orifice. On account of their age and generally poor health these patients are considered poor operative risks and are seldom advised to submit to even an exploratory laparotomy.

However, it is to be remembered that in spite of the clinical symptoms and even examination of the pyloric mass at an exploratory laparotomy leading one to believe the condition to be a malignant one, the obstruction may occasionally be the result of an inflammatory process around an old ulcer. Consequently startling improvement may be obtained in some of these patients following a so-called palliative gastroenterostomy.

During the past few years I have had a small group of cases that bring out this point and although considered bad risks to start with, have come through their operation and postoperative course very well. In presenting them it is with the hope that other surgeons will operate upon similar patients with a little more enthusiasm.

The series was made up of eight patients, two female and six males, the youngest fifty-one and the oldest seventy-four. Most of them gave only a comparatively short history of pain, indigestion, loss of weight, etc. Some had severe complications, one was a severe diabetic, one was a cardionephritic with diabetes, another was said to have spinal lues and still another had a chronic asthmatic cough. In spite of these complications they all survived their operative procedures.

Their case histories briefly summarized follow:

CASE I. Mrs. G. P., sixty years old, married, had been well up to several years ago when she began to have pains in the pit of her stomach, gastric upsets and belching. X-ray at that time revealed a nonfunctioning gallbladder and what was suspected to be a distorted duodenum. She was placed on a diet and improved for a while. Later her symptoms returned, accompanied by severe pain after eating. She began to vomit and as a result was afraid to eat and lost a good deal of weight. X-rays were taken again showing a definite pyloric stenosis with a duodenal ulcer. She finally consented to operation and was found to have a mass of adhesions about a thickened gallbladder which was also adherent to the duodenum. The pylorus was narrowed to a very small opening as a result of these adhesions and there was a cicatrizing ulcer in the first portion of the duodenum. A cholecystectomy and posterior gastrojejunostomy were done. The patient stood the procedure well and left the hospital in about two weeks. Up to the present she feels well, is eating a full diet and has no gastric discomfort.

CASE II. Mr. P. P., fifty-nine years of age, gave a history of pain in the pit of his stomach, loss of weight and inability to swallow food.

Up to April, 1939, the patient had always been active and in good health. He then suddenly noticed that he had polyuria, thirst and a ravenous appetite. He was examined and found to be a severe diabetic. He improved somewhat and went to Europe for several months but on his return at the beginning of September his diabetes was not under control and he was losing weight. In spite of therapeutic measures he continued to lose weight and found that he could not retain food. He began to have epigastric pain and to regurgitate undigested food once or twice a week. X-rays taken at the end of September showed complete pyloric obstruction with marked gastric dilatation. In spite of repeated washings, the patient did not improve and became so dehydrated that he was admitted to Wickersham

Hospital. There he was given large doses of insulin, blood transfusions and as he improved a good deal he was explored. A large obstructing mass was found at the pylorus with an edematous dilated stomach. A quick posterior gastrojejunostomy was done and he stood the shock of the operation very well and left the hospital two weeks later with blood sugar of 122 mg. Since then he has been able to eat fairly well but his diabetes is still a problem. He has, however, gained twenty-four pounds since the operation.

CASE III. Mr. L. D., fifty-one years of age, was referred by Dr. Bassler. He suffered with pain in the epigastrium, nausea and vomiting. The patient had had a cholecystectomy two years previous since which time he had had epigastric pain. This had no relation to meals or type of food eaten. His attacks of vomiting brought up dark brown material but no blood. He claimed he had not lost weight but his family said he had. X-rays showed a definite pyloric obstruction. Repeated gastric lavages showed complete retention and consequently because of the persistent pain he was considered a case of gastric carcinoma.

Laparotomy on April 8, 1939 revealed a mass of omental adhesions to the old gallbladder scar. Further exploration revealed a tumor mass the size of an orange at the pyloric end of the stomach firmly adherent to the gallbladder bed and to the pancreas. The stomach itself was dilated and somewhat edematous.

As there was no way to free the tumor a simple posterior gastrojejunostomy was done. He had an uneventful postoperative course and went home two weeks later. He has since returned to work as a fire captain, eats well and has no pain.

CASE IV. Mrs. E. M., fifty-one years of age, was referred by Dr. Spencer. She had been vomiting and bringing up blood for a month. The patient had been vomiting immediately after eating for several weeks and at times it was accompanied by bright blood. She had pain after eating for several years which usually was relieved by alkalies.

The past history revealed that the patient always had indigestion and had been in hospitals for the same trouble. She had lost a good deal of weight lately, now being only 110 pounds. Gastric analysis showed the presence of free hydrochloric acid, no blood but traces of bile. X-rays showed an indurated ulcer of

the lesser curvature of stomach probably malignant with partial pyloric obstruction.

Operation on September 15, 1939, showed a chronic gastric ulcer on the lesser curvature with pyloric obstruction, adhesive perisplenitis and calcified mesenteric lymph-nodes. A subtotal gastrectomy and an anterior gastrojejunostomy were done and the calcified lymph-nodes removed.

She had a stormy postoperative course regurgitating her food for over ten days. She was kept going by continuous intravenous glucose infusions and finally straightened out. Her wound nearly disrupted but eventually healed solid and she left the hospital in good shape. At present she weighs 123 pounds and eats nearly everything without discomfort.

CASE V. Mr. L. M., seventy-four years old, was referred by Dr. Lardaro. He had had periodic attacks of severe pains, nausea, vomiting and weakness.

Patient gave a long history of attacks of abdominal pains. He had been known to have had a peptic ulcer for at least twenty years and for the last ten years had had symptoms of pyloric obstruction. In 1936, X-rays showed nearly complete pyloric obstruction. At that time the symptoms were relieved by gastric lavages and sedatives. For the last six months he had been losing weight, had not been able to eat and had had constant epigastric pain. He also vomited large quantities of food at times. On admission at Misericordia Hospital gastric lavages brought back over thirty-two ounces of foul smelling fluid. Repeated washings always showed retention. X-rays revealed a marked gastric dilatation with complete pyloric stenosis.

He was operated upon February 23, 1940 and a mass of omental adhesions was found between the anterior abdominal wall, the liver and gallbladder. There was evidence of a plastic peritonitis about the right lobe of the liver. The gallbladder itself was not very thick but about three times the normal size. On further exploration a large mass was found involving the pylorus, first portion of the duodenum adherent to the liver and pancreas. No palpable nodes were felt.

After division of the adhesions, the gallbladder was removed and as the pyloric mass was firmly fixed a simple posterior gastrojejunostomy was done. Pathological report was chronic cholecystitis.

He developed a postoperative pneumonia but this cleared up in a few days. His sutures were removed on the twelfth day, the wound healed well and he went home on the sixteenth day. He has since been very comfortable, regaining his normal weight.

CASE VI. Mr. G. L., fifty-seven years old, was referred by Dr. J. Lauricella. He had had pain in the pit of the stomach, radiating then to the back. The patient had had symptoms of indigestion for several years and lately had not been able to retain food. Pain was constant and he had lost a great deal of weight and had become jaundiced.

Past history revealed no previous operations; he was married and had several children. He is said to have contracted lues many years ago and had developed symptoms of locomotor ataxia. He did have a positive spinal Wassermann test but following a long course of treatment it became negative. Stools were nearly clay colored.

He was a small, somewhat emaciated, jaundiced individual walking with an ataxic gait. Abdominal palpation revealed a sensation of a mass in the midepigastrium.

Laparotomy revealed a hard nodular mass involving the pylorus, base of gallbladder and head of pancreas. The gallbladder itself was markedly distended with bile. As a palliative procedure it was decided to do a cholecyst-gastrostomy and a posterior gastrojejunostomy. This was done at one operation and the patient stood the procedure very well, as a matter of fact he did not regurgitate any bile or fluid through the Levine tube. He rallied very quickly and went home in a little over two weeks with no biliary drainage. He has slowly been able to regain his appetite, has gained eight pounds in weight and his jaundice has cleared up.

CASE VII. Mr. DeM., sixty years old, was referred by Dr. Constantine. The patient was admitted to Parkway Hospital on January 20, 1939, with a story of marked loss of weight and weakness but only two weeks' history of pain in the right side of abdomen. For the last week he had not been able to retain any food and would occasionally vomit a clear mucoid fluid.

His previous history was negative for any serious illness but he was known to be a diabetic for the past eight years. On admission physical examination revealed a man with a

large frame who apparently had lost a good deal of flesh. Hemoglobin 40 per cent; red blood cells 2,290,000 and 4,100 white blood cells. Urine showed traces of albumen and sugar and many hyaline and granular casts; blood sugar 148 mg., gastric analysis showed free hydrochloric acid 28, total acidity 88; stool showed traces of blood; blood pressure 180/70. Barium enema showed no evidence of malignancy. X-ray of stomach showed a complete pyloric obstruction probably due to a malignancy.

His general condition improved with medication, infusions and transfusions but he could not retain anything in his stomach. It was then decided to perform an exploratory operation and this was done on February 14, 1939, about four weeks after admission. At operation a slight amount of serosanguineous fluid was found in the cavity. The first portion of the duodenum was covered over by plastic adhesions. The duodenum itself seemed fused to the head of the pancreas into one mass and the pancreas itself was hard and nodular. The stomach itself was extremely edematous. A tentative diagnosis of neoplasm of the head of the pancreas was made. As a palliative measure a posterior gastrojejunostomy was done. There was no reaction. The patient very shortly began to take food by mouth and quickly grew stronger. In spite of our fear of a disrupted wound he healed solidly and went home about three weeks after the operation. He has since been examined repeatedly and at present, eighteen months later, has gained twenty-one pounds and has no difficulty with his digestion.

CASE VIII. Mr. J. A., seventy years of age, on November 2, 1939, gave a history of vague abdominal pains and periodical attacks of vomiting which were present for four months.

This man was in good health, except for a chronic asthma, up to four months ago when he began to have abdominal pains particularly after eating. This grew worse and he lost his appetite. X-ray show complete pyloric stenosis with marked gastric retention. Gastric lavages showed retention, traces of blood but free hydrochloric acid. He was a difficult case to handle as he was very unco-operative. Following a 500 cc. transfusion of whole blood he was explored on November 6, 1939. He was found to have a large indurated mass on the lesser curvature of the stomach extending into the pylorus and obstructing it. The gastrohepatic omentum was congested and there were

several hard lymph-nodes present. The liver appeared normal.

In view of the age of the patient no radical surgery was considered, only a posterior gastrojejunostomy being done. Following the operation he developed a congestion at both bases and a nasty productive cough but all the signs cleared up and he left the hospital on the sixteenth day with the wound almost completely healed. He at present is eating a full diet without discomfort and his wound is solid.

Before taking up for discussion some points brought out in this small but interesting group of cases we wish to repeat that for the sake of brevity the case reports were made as short as possible, but that in every respect the cases were completely worked up before operation and carefully followed up to the present time. No biopsies were done because at the time of the operation either the mass was considered definitely malignant or there was fear of starting uncontrollable bleeding.

COMMENT

It may be noted, first, that in many of the patients the symptoms of pain, indigestion, loss of weight, etc., were all of short duration. Where they had been present for some time, there seemed to be a definite change, the patient rapidly losing weight and showing definite signs of pyloric occlusion.

Second, in all the x-ray studies the obstruction at the pylorus seemed to be nearly complete accompanied by marked gastric retention. This was interpreted as showing that the lesion was of long standing and probably malignant.

Third, six cases at operation were believed to be infiltrating growths at the pylorus, not resectable in view of the exten-

sion into the surrounding organs. The seventh was considered definitely a pyloric ulcer but the eighth case, in which a subtotal gastrectomy was done, was also suspected to be a malignant degeneration in an ulcer on the lesser curvature.

Fourth, besides a posterior gastrojejunostomy it was found necessary to do a cholecystectomy in two and a cholecyst-gastrostomy in another on account of dense adhesions involving the gallbladders and the obstruction of the bile ducts causing severe jaundice in the third.

Fifth, in spite of being over fifty and most of them suffering from other diseases: diabetes, asthma, hypertension, etc., the patients were all able to withstand major surgical procedures, recover from the operation, regain their strength, be able to eat almost all foods and put on quite a few pounds in weight. I believe this result was obtained by careful preoperative study and preparation, regulation of their diabetes, prolonged bedrest, and the administration of adequate amounts of fluids, blood, etc., before and after the surgical procedure.

CONCLUSION

Pyloric obstruction in patients past middle life is not always caused by a malignant growth. In spite of a relative short history the condition may be the result of an inflammatory process about an old gastric or duodenal ulcer.

Even though the clinical symptoms and roentgenological findings point to a neoplasm, an exploratory laparotomy is justifiable.

With proper preparation these patients withstand major surgical procedures well and remarkably good results may be obtained.



THE TREATMENT OF LARGE HYDROCELES BY INJECTION OF SODIUM MORRHUATE*

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WITH the exception of epididymitis, hydrocele is the most frequently encountered tumor of the scrotum. It is an abnormal accumulation of serous fluid between the two layers of the tunica vaginalis testis. Normally, a few drops of fluid are present within this cavity and serve to moisten its surfaces.

The serous lining of the hydrocele sac is derived from the saccus vaginalis of the peritoneum, which preceded the descent of the testis from the abdomen into the scrotum. The testis and epididymis are invaginated by this membrane. It may be described as consisting of a visceral and a parietal layer; the potential space between these two layers forms the hydrocele pouch. After the descent of the saccus vaginalis that portion which extends from the peritoneum to just proximal to the head of the epididymis becomes obliterated. In the adult, the tunica vaginalis alone persists so that hydrocele of this portion of the saccus vaginalis is the type usually encountered. The obliterated portion of the saccus vaginalis can often be seen lying in the loose areolar tissue that surrounds the spermatic cord. If this portion of the saccus vaginalis does not become obliterated throughout its course from the abdomen to near the head of the epididymus, a variety of congenital abnormalities results, particularly hydrocele and hernia.

Hydroceles may be classified according to their location, as congenital, infantile, ordinary, hydrocele of the cord and hydrocele of the hernial sac. (Figs. 1, 2 and 3.) Classified as to etiology, hydroceles are divided into congenital, acquired and idiopathic. Congenital indicates that the condition was present at birth; ac-

quired, that the etiological factor was some disease or trauma of the scrotal contents; and idiopathic, those of indefinite origin. The vast majority of hydroceles are acquired and originate as a complication of injury or disease of the scrotal contents. Those that are due to injury or disease are also classified as symptomatic or secondary hydroceles. The symptomatic hydrocele may be acute or chronic, depending upon the primary scrotal lesion. The idiopathic hydrocele is always of the chronic type, slow in its development and the etiological factor impossible to determine.

If the history alone is used as the basis of classification, the majority of hydroceles will fall in the idiopathic group, because patients frequently are unable to recall any injury or disease that could account for the hydrocele. Fluid does not collect in abnormal amounts in other normal serous cavities, then why should it collect in the tunica vaginalis unless some antecedent injury or disease was responsible. Careful examination of the epididymis at the time of operation will in practically every instance, except in the congenital type, reveal cicatricial tissue, adhesions and thickening. This indicates that some inflammatory process preceded the hydrocele. Mild asymptomatic epididymitis is of more frequent occurrence than is generally recognized and is probably the predisposing cause of idiopathic hydrocele. The epididymitis may have been so mild that it passed unnoticed or was forgotten. Any inflammatory process of the tunica, primary, or secondary, from either the testis or epididymis, is followed by the secretion of serum into its cavity, absorption is limited and a hydrocele results. The low specific

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gravity and serum content of the transudate indicate that hydrocele fluid is an inflammatory exudate. Those that do not

patients. Fifteen were congenital in origin and ten of these were in infants. Of the 306,387 admissions, 18,963 were males and

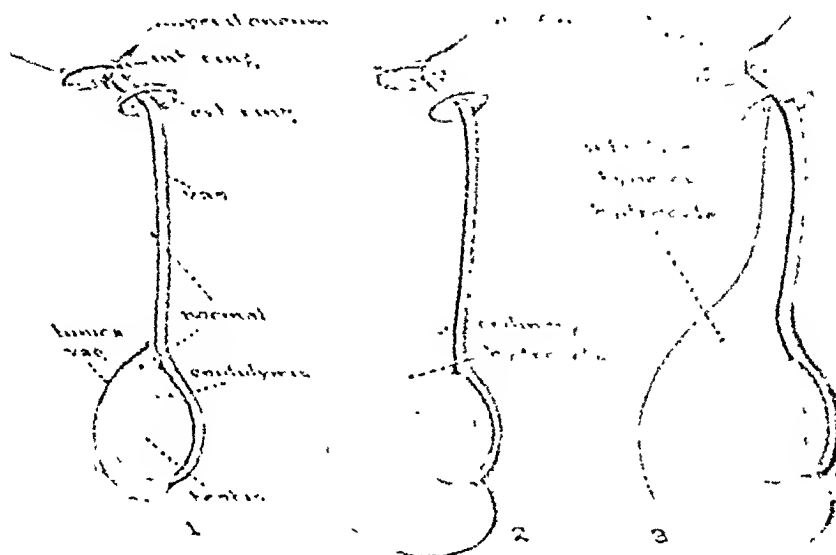


FIG. 1. Schematic drawing showing: (1) normal relationship of tunica vaginalis testis; (2) simple vaginal hydrocele; (3) infantile hydrocele, the frequent variety. (Greene, *Am. J. Surg.*, April, 1937.) (Herman, *The Practice of Urology*, Philadelphia, 1938. W. B. Saunders Co.)

hold with this theory ask, Why does not hydrocele follow acute epididymitis in a higher percentage of cases? In acute epididymitis the inflammatory reaction is so marked that the serous layer of the tunica vaginalis is destroyed, or becomes so sclerosed and thickened that it prevents the secretion of serum and the formation of a hydrocele.

Congenital hydrocele is the type usually observed in the young. Campbell¹ in the examination of seventeen boys under six years of age with hydrocele, found that the condition had existed since birth in thirteen. Vallery-Radot, Vaglio, and Sales² believe that congenital syphilis is one of the chief predisposing factors in congenital hydrocele. In 115 cases of congenital syphilis examined by them 20 per cent had hydrocele, and in fifty-five congenital hydroceles, 40 per cent had congenital syphilis.

Campbell³ in a review of 306,387 admissions to Bellevue Hospital during a seven-year period, found 502 hydroceles in 446

12,274 were admitted to the urologic service. Four hundred forty of the urologic admissions complained of hydrocele. This represented 3.6 per cent of the urologic admissions and .24 of the male admissions, or 1 in 400. Ninety per cent of these were over twenty-one years of age. There was a slight predilection for the right side: 50.2 per cent on the right and 41 per cent on the left, and bilateral involvement was present in the remainder.

Uninfected hydrocele fluid resembles blood serum; the specific gravity varies from 1.020 to 1.026. If infection has taken place, the fluid has a hazy or cloudy appearance due to leukocytes and bacteria. If there has been recent intratunical hemorrhage, the color of the fluid will vary from pink to a deep red. A brownish dirty fluid indicates an old hemorrhage.

The normal tunica vaginalis is thin and pale in color. In acute inflammatory conditions it is red, injected and edematous. If the hydrocele is of long duration and has been subjected to frequent tappings or

inflammatory reactions, the tunica will be greatly thickened and at times almost cartilaginous in nature. On rare instances, a

chronic pyogenic disease is to be differentiated from idiopathic hydrocele and the co-existing pathology diagnosed. Bilateral

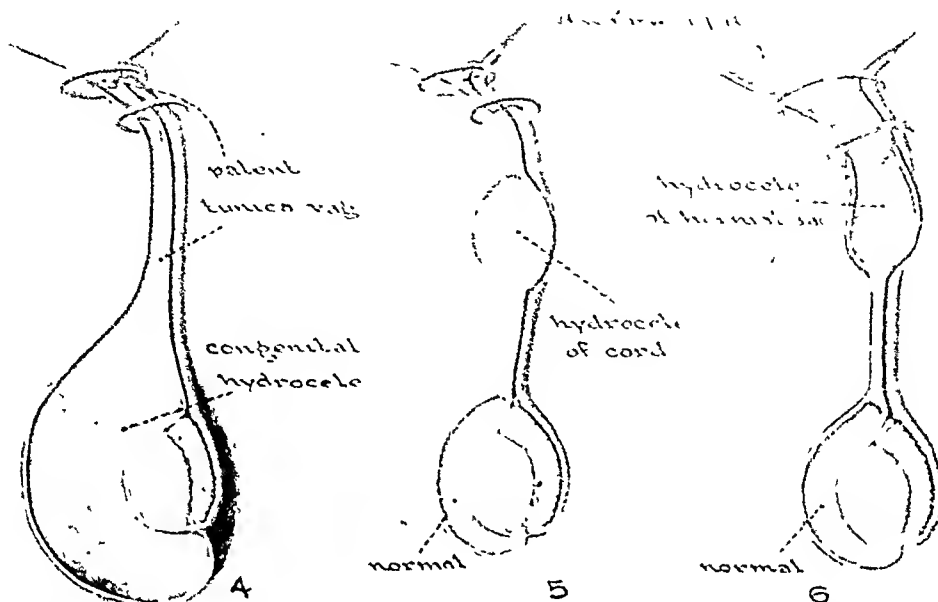


FIG. 2. (4) Congenital hydrocele; (5) hydrocele (eneysted) of the cord; (6) congenital funicular hydrocele. (Greene. *Am. J. Surg.*, April, 1937.) (Herman. *The Practice of Urology*. Philadelphia, 1938. W. B. Saunders Co.)

hydrocele is encountered in which calcification of the tunica vaginalis has taken place. The majority of hydroceles contain only one cavity, occasionally the multilocular type is encountered.

The symptoms in chronic hydrocele are few. There is present a unilateral painless enlargement of the scrotum. The enlargement develops slowly and frequently the date of the onset is unknown. It is not uncommon for a patient with a hydrocele that contains from two to four ounces of fluid, to insist that it developed overnight, without there being present any acute condition to account for its presence. Here the enlargement had developed slowly and had passed unnoticed until it was discovered during bathing or dressing, or was noted by someone else. The large hydrocele may produce a dragging down sensation in the inguinal region due to its weight. At times, the only complaint may be that it produces a noticeable bulge or interferes with sexual relations.

Chronic symptomatic hydrocele due to neoplasm, tuberculosis, syphilis or other

chronic hydrocele in the adult may be due to syphilis or tuberculosis. Those due to syphilis frequently disappear when anti-luetic therapy is instituted.

In acute hydrocele, pain and swelling are the chief symptoms. The scrotal wall is thickened and presents evidence of an acute inflammatory reaction. The pain is due to pressure produced by the rapid accumulation of fluid in the acutely inflamed tunica or to the underlying pathologic condition. The pain may be referred to the inguinal region or the lower quadrant of the abdomen due to the presence of an acute vasitis or seminal vesiculitis. Acute hydrocele is always secondary to an inflammatory condition of the testis or epididymis, or results from trauma.

A smooth, painless, pear-shaped scrotal tumor that can not be reduced is usually a hydrocele. The hydrocele sac tapers towards the inguinal region and the cord can be palpated above it. A cough impulse is obtained only when the hydrocele is complicated by a hernia. In congenital hydrocele there is a direct communication be-

tween the tunica vaginalis and peritoneal cavity. It is the only type that is reducible. The opening into the peritoneal cavity may

cele is seldom encountered, is usually smaller than hydrocele and the testis is in front and below the sac, whereas in

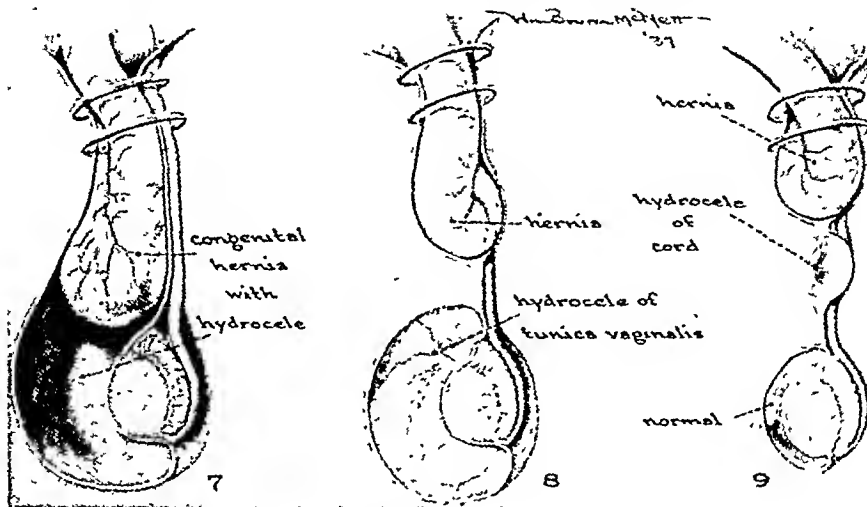


FIG. 3. (7) Congenital hernia with hydrocele; (8) simple (vaginal) hydrocele with incomplete hernia; (9) hernia and hydrocele of cord. (Greene. *Am. J. Surg.*, April, 1937.) (Herman. *The Practice of Urology*. Philadelphia, 1938. W. B. Saunders Co.)

be so small that pressure fails to produce an immediate reduction in the size of the tumor. In the young, it is advisable to compare the early morning and afternoon size of the scrotum. Through a small opening, the fluid may empty into the peritoneal cavity during the recumbent position of sleep.

Hydrocele must be differentiated from hernia, varicocele, spermatocele and hematocele. It is not always possible to determine if the scrotal enlargement is due in its entirety to a hydrocele. In most instances the diagnosis can be made by transillumination. Thickening of the tunica and marked turbidity of the fluid due to pus, bacteria or hemorrhage may prevent or diminish the translucency. In infants, due to the thinness of the underlying structures transillumination of a hernia is possible.

Hernia gives an impulse on coughing, and is usually reducible, or a history is obtained of its having been reducible. A varicocele diminishes in size when the patient is in the recumbent position. Scrotal edema, due to cardiovascular disease, may be mistaken for hydrocele. It frequently will transilluminate, but there is present the characteristic pitting edema. Spermato-

hydrocele it is behind. Spermatocele usually does not transilluminate. In acute hematocele there is a history of recent trauma. Trauma to a chronic hydrocele may be followed by hemorrhage that prevents transillumination.

The transillumination should be done in a darkened room with a brilliant small, beam light. The fountain pen flash-light is ideal for this examination. If an ordinary light is employed, the scrotum should be viewed through a paper cylinder.

The history, examination and transillumination ordinarily establish the diagnosis of hydrocele. The position of the testicle is determined by transillumination and palpation is a most valuable aid in the diagnosis. A shadow in the lower posterior portion of the pink cysts, produced by the transillumination, represents the testicle and confirms the diagnosis. If a neoplasm or co-existing pathological condition of the testicle is suspected, tapping greatly facilitates the examination. Tapping is contraindicated in the absence of light transmission.

Hydrocele, unless complicated by hernia, neoplasm, tuberculosis or other disease, is never dangerous to life. Suppuration and hematocele do not occur in the idiopathic

hydrocele except as the sequela of tapping or trauma, but may occur in those due to neoplasms, tuberculosis and syphilis.

must be employed to prevent infection. It may be utilized with safety and the assurance of good results in the simple chronic

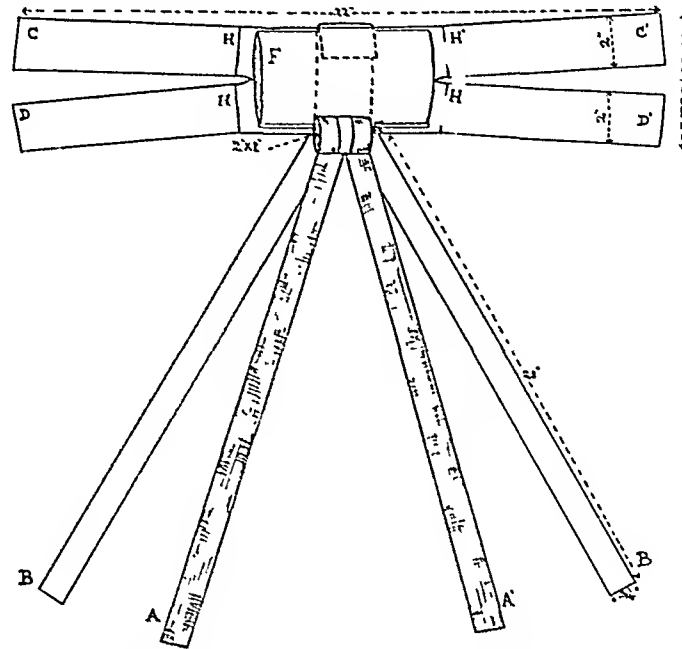


FIG. 4. A sketch of modified Bellevue adhesive suspensory with dimensions.

TREATMENT

There are three recognized forms of treatment in hydrocele: tapping, injection, and surgery.

Tapping as a method of treatment should be employed only in infants and young children. In this group, it frequently is curative and should be given a trial before more radical measures are advised. In the adult it is rarely curative and gives only temporary relief.

The injection treatment of hydrocele was frequently employed forty years ago. Iodine and carbolic acid were the original solutions used for injection. With the perfection of operative procedures, the injection treatment was discarded because of the uncertain results, infection, necrosis and local reaction that at times necessitated an orchidectomy. In recent years several authors have reported excellent results in the injection treatment of hydrocele, employing the solutions used in the injection treatment of varicose veins.

Injection treatment is an office procedure, but unquestionable sterile technic

hydrocele. One of the principal objections to this form of treatment is the possibility of overlooking co-existent pathological conditions. The history, examination of fluid, and palpation of the testis following aspiration should reduce to a minimum this error. If the aspirated fluid is bloody, or contains pus and bacteria, injection is contraindicated.

The scrotum should be shaved and scrubbed with soap and water preceding the injection. Two areas in the scrotum wall that transilluminate and are relatively free of large blood vessels are selected. These areas are infiltrated with novocain. A No. 18 to 20 gauge needle is inserted through the anesthetized skin and pushed for one-half inch through the subcutaneous tissue and then plunged into the hydrocele sac. This method of inserting the needle prevents leakage of the sclerosing solution through the scrotal wall. A smaller needle is inserted into the other anesthetized area in the same manner. This aids in the aspiration of the fluid as it destroys the negative pressure. The fluid is withdrawn,

and sufficient 2 per cent novocain solution is injected through the large needle to distend slightly the sac and to surround the

morrhuate at the original injection but this will increase the reaction. The purpose of the injection is to produce sufficient inflam-

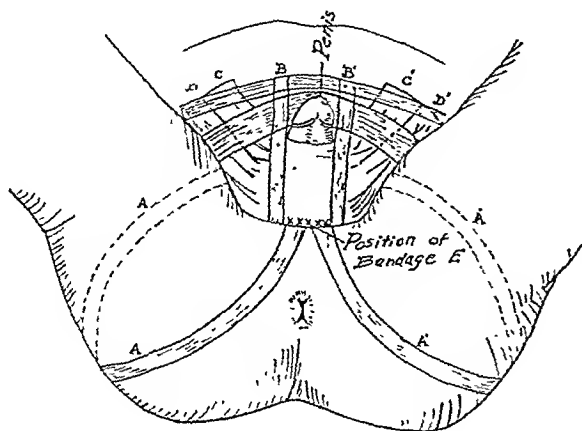


FIG. 5. Perineal view of patient with suspensory applied; scrotum compressed and elevated by suspensory.

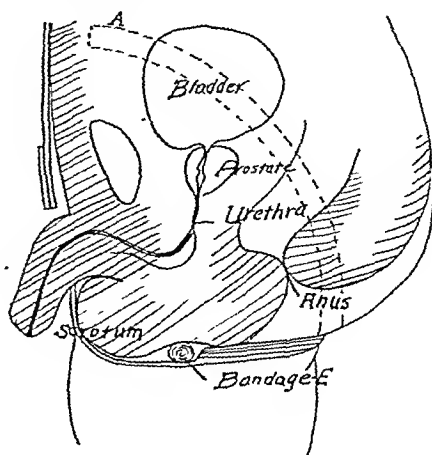


FIG. 6. Lateral view, showing how bandage E prevents the scrotum from slipping posteriorly.

testicle completely. The novocain reduces the pain from the sclerosing solution. It is permitted to remain in the cavity for ten minutes. Following its aspiration, 3. cc. of 5 per cent sodium morrhuate with benzyl alcohol is injected into the hydrocele sac. The needles are withdrawn and the scrotum massaged to secure an even distribution of the solution through the cavity. A modified Bellevue adhesive suspensory (Figs. 4, 5 and 6) is applied and the patient ordered to remain in bed for two days. If pain follows the treatment, a mild narcotic is prescribed. There is usually a moderate amount of swelling of the scrotum and a reaccumulation of fluid in from seven to ten days. The pain, swelling and reaccumulation of fluid is restricted by the use of the modified Bellevue adhesive suspensory. Aspiration is indicated when sufficient fluid has reaccumulated to distend the tunica. This fluid has a hazy appearance and contains fibrin and leukocytes. If there is a second reaccumulation of serum, the injection is repeated. By using small amounts of sodium morrhuate and repeating the injection when indicated, satisfactory results with a minimum of reaction will be obtained. A second treatment may be avoided by utilizing a larger amount of sodium

matory reaction to destroy the secreting surface of the serous membrane and to obliterate the sac.

The following table shows briefly the results obtained in the injection treatment

Name and Age	Cc. Fluid	Number Treatments, Sodium Cc. Morrhuate	Number Simple Aspirations	Days of Treatment
A. C. 42	150	1-3	1	14
J. D. 53	360	1-3	1	36
W. M. W. 65	570	1-5	1	12
J. P. 75	660	1-5 1-5	1-180 cc. 1-150 cc. 1-250 cc. 1-30 cc.	47
P. W. 71	330	1-5	1	30
S. R. B. 50	540	1-3 1-2	1-250 cc.	22
D. D. 26	660	1-3 1-3	1-200 cc. 1-100 cc. 1-30 cc.	60

of seven large hydroceles in nonhospitalized patients.

An immediate cure was obtained in all cases. One-half of the patients were located at the end of two years; there was a complete cure without complications in those cases located.

The radical operation for hydrocele is a very satisfactory procedure and if properly performed should be accompanied by few complications. The injection treatment is not recommended as a procedure to replace the radical hydrocele operation. It will give satisfactory results in large or small chronic hydroceles, and is recommended when the operation is contraindicated or refused.

SUMMARY

Hydrocele is a relatively common condition in adults. In infants it is frequently

congenital and connects with the peritoneal cavity.

Mild asymptomatic epididymitis is probably the underlying pathology responsible for the majority of hydroceles.

Tapping is frequently curative in the young but seldom the adult.

Excellent results can be secured with the injection treatment of large hydroceles without co-existing pathological conditions, but as is true of all closed methods of operation, hemorrhage and infection may occur.

The use of the modified Bellvue adhesive suspensory will reduce the local reaction and increase the patients comfort.

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THE SUBMUCOUS METHOD IN THE TREATMENT OF ANORECTAL DISEASES

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IN my recent article on submucous hemorrhoidectomy¹ I described briefly a new method of approach in the treatment of hemorrhoids. Since I had not covered in detail the procedure for all types of hemorrhoids, I wish to describe here a simplified technic for the combined external and internal hemorrhoid.

COMBINED HEMORRHOID

The combined hemorrhoid is simply an extension of the internal swelling, this portion being covered by skin instead of mucosa. Under local or general anesthesia, a v-shaped incision is made at the base of the external hemorrhoid. The cut edge is held gently with an Allis clamp and the skin and mucous membrane covering the combined hemorrhoid is undermined with a blunt, curved, flat-blade scissors. (Fig. 1A.) The mucocutaneous flap is then split along its entire extent thus exposing the hemorrhoidal mass. A suture ligature of No. 00 plain catgut on a small round curved needle is then passed around the apex of the hemorrhoid. The phlebotic mass with its perivascular areolar tissue is completely dissected from its bed. (Fig. 1B.) The resulting two mucocutaneous flaps are allowed to cover the denuded surface. If the flaps are too redundant, they may be trimmed to the proper width, remembering it is preferable to leave a little more than too little tissue in order to avoid either stricture or ectropion. These free flaps, covering the underlying raw surface, will agglutinate readily and heal in a very short time acting like an epithelial graft with a broad pedicle in any vascular area.

ULCERATED HEMORRHOIDS

In treating ulcerated hemorrhoids, it is not necessary to separate the entire mucosa

covering the hemorrhoid. I find it more expedient to undermine the mucosa up to the margin adhering to the ulcer. The hemorrhoidal mass is then removed together with the adherent portion of the mucosa thus leaving behind two healthy flaps with which to cover the raw surface. The after treatment employed in submucous hemorrhoidectomy has been described in my previous article on this subject.

Having found this technic so completely successful in the treatment of all types of hemorrhoids, I have extended the application of this method to other pathologic conditions present in the anorectal region, such as anorectal stricture, anal fissure, anal fistula and rectal polyps.

ANORECTAL STRICTURE

Anorectal stricture denotes a constriction of the lumen of the anal canal. This condition may be either benign or malignant. I shall consider only the benign strictures. These are usually due to such causes as anorectal fistulae or their improper excision; it may also follow injections of chemicals for the treatment of hemorrhoids and pruritus ani, after operative treatment of hemorrhoids in which too much skin and mucosa have been removed or after hemorrhoidectomy by the cauterization method. This condition causes difficult and painful bowel movements sometimes tinged with blood and pus due to a superimposed infection. Occasionally, hard fecal matter forced through a constricted anal orifice will cause the formation of fissures.

The various treatments advocated for this condition have not proved satisfactory. Forcible dilatation of the stricture is frequently unsuccessful on account of the